VILLAGE OF MONSANTO, ILLINOIS

DEVELOPMENT OF PLAN OF RELIEF FOR SEWER SYSTEM

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64-73

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February 23, 1965

Honorable Mayor and Board of Trustees
Village Hall
Village of Monsanto
Monsanto, Illinois

Gentlemen:

In accordance with the instructions of the Village of Monsanto as transmitted to us through Mr. Joseph W. Goldenberg of Joseph W. Goldenberg and Associates, we are pleased to submit this report relating to the development of a plan of relief of the existing sewer system for the Village of Monsanto.

A summary of the principal conclusions and recommendations resulting from the study presented in this report is included after the title page.

We appreciate the opportunity of performing this study for you. Should our conclusions and recommendations require further consultation and discussion, we are at your service.

Respectfully submitted,

HORNER & SHIFRIN
Consulting Engineers

E. E. Bloss, Partner

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FEW/jm
Encl.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The purpose of the study summarized in this report is to develop a comprehensive plan of relief for the existing sewer system of the Village of Monsanto. The principal conclusions and recommendations resulting from the study are summarized briefly in the following:

1. The existing combined sewer system of the Village makes use of two surge ponds to accommodate fluctuation in waste water flow, under both dry weather and storm flow conditions.

2. Without the surge ponds, the existing Village combined sewer system would be grossly inadequate.

3. The presence of polluted waste waters in the surge ponds results in the deposition of solid materials on the bottoms and banks of the ponds, thereby creating nuisances and potential fire hazards, which are objectionable to certain of the local industries.

4. From every indication, the Village will be required to discontinue the discharge of polluted waste waters into the surge ponds within a relatively few years.

5. The natural channel of Dead Creek affords a means of draining storm runoff from part of the Village, thereby allowing less extensive improvements in the present sewer system than would otherwise be required.

6. The most practical and economical long range plan of improvement to the Village sewer system includes making use of the channel of Dead Creek for the discharge of part of the relatively clean waste water and storm drainage from the Village, and the construction of relief sewers for a substantial part of the existing Village sewer system. This plan is recommended for adoption by the Village. Alternate plans of relief were explored in this study, but were found to have no advantages over the plan recommended.

7. The capacity of the existing pumping station and outlet conduit to the Mississippi River is inadequate to handle the anticipated combined dry weather and storm flow. This applies as well

to the capacity of the proposed new Corps of Engineers pumping station.

8. The estimated cost of the improvements recommended in this report, not including certain improvements being investigated by others, is $2,070,000.

9. It is recommended that competent legal counsel be retained to explore immediately the rights of the Village to discharge storm drainage as well as clean dry weather waste water flow to the channel of Dead Creek.

10. It is recommended that negotiations be initiated immediately with the Corps of Engineers to increase the pumping capacity of their proposed new pumping station to 200 cfs at River Stage 13.

11. It is recommended that all of the tributary industries be requested to examine their plant sewer systems and water usage to determine how much clean water and storm runoff could practicably be diverted to the proposed new clean water sewer.

12. Assuming adoption of the plan recommended in this report, it is suggested the Village promulgate regulations for the use of the Village sewer system. Such regulations should forbid any additional clean water or storm drainage from being discharged to the Village combined system and should define the quality of waste water permitted in the proposed clean water sewer.

13. Substantial savings in sewer service charges could be effected by certain of the tributary industries if portions of their clean waste water were discharged to the channel of Dead Creek and kept out of the Village combined system.

14. Construction costs have been increasing at the approximate rate of 5 per cent per year, and there is no indication that this rate will decrease. Since it appears inevitable that polluted waste water will have to be eliminated from the existing surge ponds, and since there is no apparent advantage in deferring the construction of the improvements as proposed, it is recommended that the Village proceed with the proposed program of improvements as expeditiously as possible.

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DEVELOPMENT OF PLAN OF RELIEF OF

VILLAGE OF MONSANTO

SEWER SYSTEM

PURPOSE AND SCOPE OF STUDY

The purpose of the study summarized in this report is to develop a plan for the relief of the sewer system of the Village of Monsanto, Illinois, to accommodate both present and anticipated future conditions. The existing sewer system, when only moderate rainfall runoff occurs, allows polluted waste waters to back up into certain industrial areas, thereby creating nuisances and other undesirable conditions. Even during dry weather, when all flow is polluted waste water, the existing system is dependent upon the utilization of a natural drainage channel as a surge pond into which a portion of the polluted waste water is diverted whenever the carrying capacities of the sewers are exceeded.

The study is concerned mainly with the disposition of storm runoff. However, since the existing sewers function as a combined system, the study necessarily includes consideration of the current Village program for the abatement of water-borne pollution, and potential future requirements for abating water-borne pollution, as well as the possibilities, under the present program, of separating relatively unpolluted waste waters from polluted waste waters.

The scope of the study is limited to the presently developed areas within the Village limits, and to those additional areas within the Village limits which show promise of development within the foreseeable future. It is recognized, however, that the disposal of a substantial portion of the unpolluted waste waters and storm drainage may be effected through drainage channels outside the corporate limits of the Village by means other than the Village sewer system as presently constituted, and consideration therefore must be given to the effects of such drainage upon those areas contiguous to the Village through which these channels run.

The scope of this report does not include the detailed study of the facilities for discharging waste water and storm flows beyond the line of protection at the existing pumping station, although the considerations involved are discussed briefly herein.

EXISTING SEWER SYSTEM

Figure No. 1 delineates the area encompassed by this study. Shown thereon are all public sewers of record as obtained from information supplied by the Village Engineer.

Sewers. The existing sewers, constructed in stages over a period of years, function as a combined system, receiving both sanitary and industrial waste flows and storm drainage. As the tributary areas have developed, the system has been expanded on several occasions, the most recent major expansion occurring in 1952. As a consequence of the increased industrial development, most of the major trunk sewers have been supplemented with parallel lines so that they now consist of multiple conduits. Almost all of the system is surcharged during periods of moderate rainfall runoff, and would be completely inadequate if two surge ponds were not presently available for the temporary storage of that portion of the flow which cannot be accommodated by the sewers. Parts of the system are surcharged on occasion even in dry weather.

The two surge ponds, one along Nineteenth Street north of Monsanto Avenue, and the other in the channel of Dead Creek south of the Alton and Southern Railroad tracks, are directly connected to the sewer system. Polluted waste waters therefore are permitted to surge into and out of the ponds, with the result that the bottoms and banks of the ponds are coated with residues from the polluted waters. It is understood that at least one fire caused by the accidental ignition of flammable residue on the banks has occurred in the Nineteenth Street pond. This pond is in close proximity to a Mobil Oil Company tank farm. The Cerro Corporation, which owns a substantial portion of the land on which the Dead Creek surge pond is located, has expressed its desire to discontinue the use of the Dead Creek channel as a surge pond for polluted waste waters because of the attendant hazards and nuisances.

Pumping Facilities. When the level of the Mississippi River is below Stage 13 (Market Street gage), the existing sewer system discharges to the river by gravity. At river levels above Stage 13, all waste water and storm drainage carried by the sewer system requires pumping in order to maintain an adequate hydraulic gradient in the system. The United States Army Corps of Engineers currently is designing a new pumping station for the Village of Monsanto sewer outlet. This new pumping station is being designed as a replacement for an existing station which had originally been constructed by the Village, and which is no longer adequate to operate against the higher river stages now anticipated as a result of the extensive construction of the downstream confinement works along the river. It is understood from the Corps of Engineers that

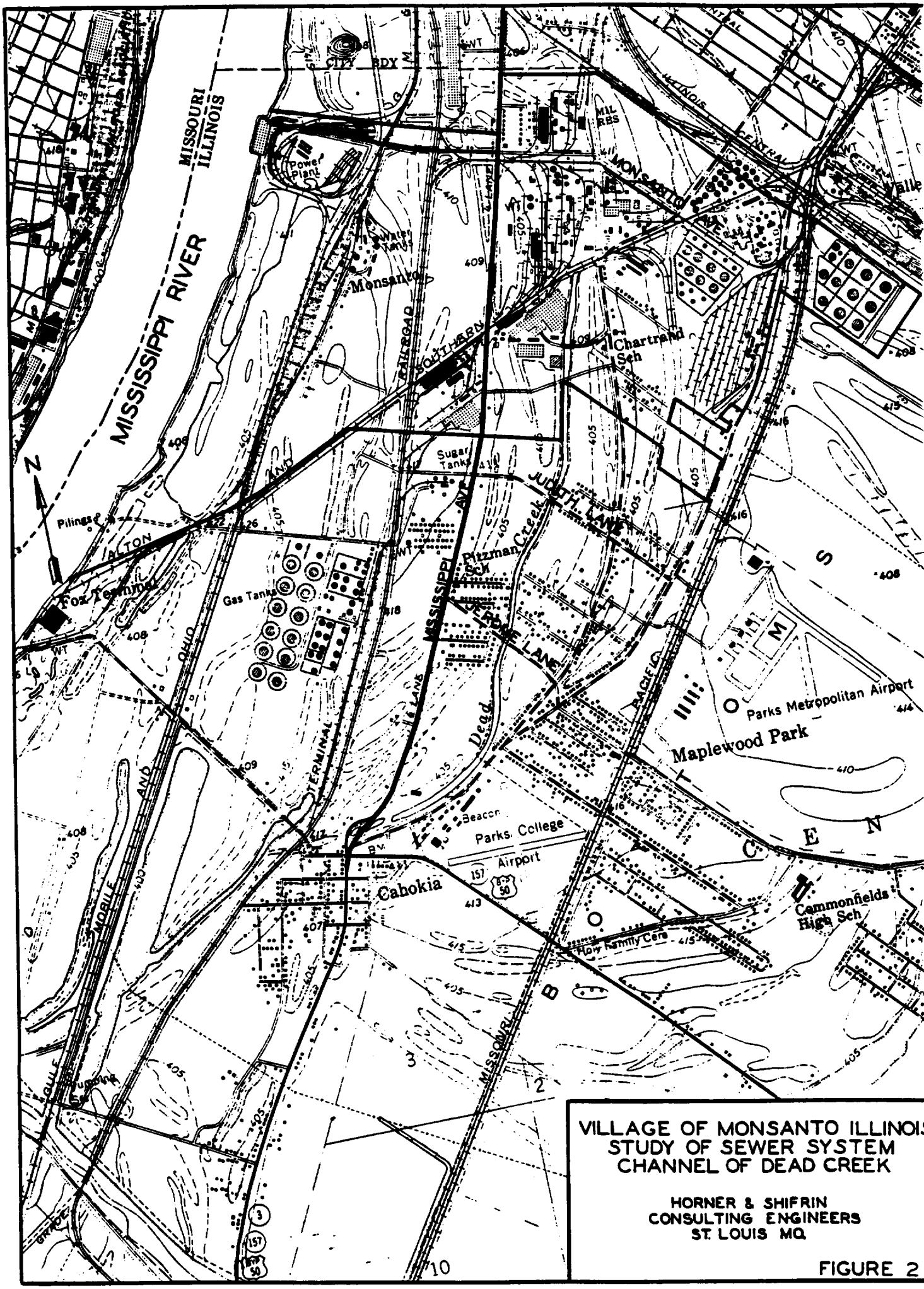
the new station will be equipped with three pumps, each capable of delivering 45 cfs at Stage 13, or 38.3 cfs at Stage 52. The station, as now contemplated, therefore will deliver a total of about 135 cfs at Stage 13, or 115 cfs at Stage 52. It is further understood the station has been designed so that its capacity can be expanded to pump 200 cfs at Stage 13. An important limiting consideration in the present system is the size of the outlet conduit between the levee and the river, since this conduit will permit a gravity flow of only about 60 cfs if a satisfactory hydraulic gradient is to be maintained at the line of protection during low river stages.

Proposed Waste Water Treatment Plant. Plans for a new waste water treatment plant for the Village have progressed to the point where bids have been taken for construction. This plant will be located near the existing Village pumping station, which will be adapted to pump waste water to the treatment facility. The plant will have a nominal capacity of 40 mgd (million gallons per day), or 62 cfs. During periods of rainfall runoff, it is understood that flow in excess of 78 cfs will be bypassed around the plant and allowed to flow directly to the river without treatment. Discharge to the river will be by gravity at stages below 13. It should be borne in mind that gravity discharge is limited by the capacity of the existing outlet to the river. This matter is discussed in greater detail later in this report.

ALTERNATE POINT OF DISPOSAL FOR STORM RUNOFF

In addition to the present gravity outlet to the river and the flood protection pumping station to be provided by the Corps of Engineers for the Village system, one additional outlet for the disposal of clean waste water and storm drainage to the Mississippi River appears to be potentially available, due to the topography of the surrounding area. This outlet consists of the channel of Dead Creek, which drains southward from the Village, and the Cahokia pumping station with its gravity outlet, which is located near the mouth of Prairie Du Pont Creek, slightly over three miles south of the Village. The Cahokia flood protection pumping station was constructed by the Corps of Engineers, and after completion was turned over to The East Side Levee and Sanitary District, which agency has assumed responsibility for the operation and maintenance of the station.

Prior to about 1940, the channel of Dead Creek provided a continuous natural outlet, from the Alton and Southern Railroad tracks in the Village to the Mississippi River, for drainage from an area which included essentially all of the Village of Monsanto. This channel and its tributaries drain generally to the south, paralleling the river, as shown on Figure No. 2. At the present time, however, the channel of Dead Creek is blocked at



VILLAGE OF MONSANTO ILLINOIS
STUDY OF SEWER SYSTEM
CHANNEL OF DEAD CREEK

HORNER & SHIFRIN
CONSULTING ENGINEERS
ST. LOUIS MO.

FIGURE 2

Judith Lane, approximately 1,100 feet south of the Village limits. The channel above Judith Lane, particularly that portion north of Queeny Avenue, serves as the surge pond previously described, and alternately receives and discharges polluted waste waters through its direct connection with the Village sewer system.

Should maximum use be made of the channel of Dead Creek for storage and as an outlet to the river for drainage from the Village of Monsanto, it first would be necessary to remove the blockage at Judith Lane. Any drainage permitted to Dead Creek would be required to be free from pollutants which might cause nuisances or public health hazards, particularly to downstream residential property owners beyond the corporate limits of the Village. It therefore would be necessary to eliminate the direct pipe connection between the creek channel and the present Village sewer system. It also would be essential that the Village enact an appropriate waste water control ordinance to help ensure nuisance-free conditions in the downstream channel of Dead Creek.

STORM RUNOFF CRITERIA

For purposes of this study, the flow from storm runoff used for design was computed to be that resulting from a storm with a five-year frequency of occurrence. The following tabulation, based upon data taken from Technical Paper No. 25 of the United States Department of Commerce, summarizes the intensities of rainfall at St. Louis, Missouri, for five-year storms of various durations. The comparable values for a two-year storm also are shown for reference.

Intensity of Rainfall

Duration (minutes)	5-Year Storm (in. per hour)	2-Year Storm (in. per hour)
5	5.70	4.65
10	4.60	3.75
15	4.05	3.10
20	3.60	2.70
30	3.00	2.20
40	2.55	1.80
50	2.30	1.65
60	2.05	1.40
120	1.30	0.89
180	0.95	0.66

Applying accepted ratios of runoff to rainfall intensity for various percentages of imperviousness of the areas drained, the computed runoff factors for such areas, in cubic feet per second per acre, are summarized in the following tabulation.

Runoff Factors

(cfs per acre resulting from 5-year storm)

Imperviousness (per cent)	Duration of Rainfall (minutes)				
	15	20	30	60	120
0	1.21	1.26	1.23	1.05	0.78
5	1.30	1.33	1.29	1.09	0.80
10	1.38	1.40	1.36	1.14	0.83
15	1.46	1.48	1.42	1.18	0.85
20	1.54	1.56	1.50	1.22	0.87
25	1.62	1.63	1.56	1.27	0.89
30	1.70	1.71	1.62	1.31	0.91
35	1.78	1.78	1.70	1.35	0.94
40	1.86	1.87	1.76	1.39	0.96
45	1.94	1.94	1.83	1.44	0.99
50	2.03	2.02	1.89	1.49	1.01
55	2.11	2.09	1.95	1.53	1.03
60	2.19	2.16	2.02	1.58	1.05
65	2.27	2.25	2.09	1.62	1.08
70	2.35	2.32	2.16	1.66	1.10
75	2.43	2.39	2.22	1.71	1.12
80	2.51	2.46	2.28	1.75	1.14
85	2.59	2.54	2.36	1.80	1.17
90	2.67	2.63	2.42	1.85	1.19
95	2.76	2.70	2.49	1.89	1.21
100	2.84	2.77	2.55	1.93	1.23

As discussed later in this report, certain of the tributary areas have limiting topographical, hydraulic and physical conditions which will prevent these rates of runoff from being realized.

LONG-RANGE CONSIDERATIONS BEARING UPON SEWER RELIEF PROGRAM

Among the factors affecting the practicality and economics of the most appropriate long-range sewerage improvement program for the Village of Monsanto are the following:

1. Barring a major economic reversal, the existing industrial developments in the Village probably will enjoy significant expansion, with corresponding increases in both polluted industrial waste water flow and in storm runoff.

2. The current Village program for the abatement of water-borne pollution, and the costs therefor, point out the economies that can be effected by most industries by adopting water conservation and waste segregation practices.

3. The existing Village sewer system, because of the corrosive nature of certain of the wastes, has been constructed of vitrified clay pipe and other materials resistant to corrosion, and consequently is of a somewhat more expensive type than would be required for non-corrosive wastes. Further, since the maximum size of vitrified clay pipe readily available was 36-inch, dual pipe lines had to be provided where the flow quantities exceeded the capacity of a single 36-inch pipe.

4. It is generally agreed that at some future date more stringent criteria will probably be imposed with regard to the quality of waste water discharged to the Mississippi River, and that the costs of treatment of polluted waste waters therefore will increase significantly.

5. As industrial plant improvements and expansion take place, it is likely that the industries will find it advantageous to include provisions for the segregation of polluted waters from relatively unpolluted waste waters and storm drainage, and that provisions to allow such segregation therefore should be made.

6. The complexity of the existing industrial processes and utilities probably will not permit complete segregation of waste waters throughout all industries in the Village. Only in some cases will it be practical to effect such segregation.

7. The proposed waste water treatment facilities for the Village will have a nominal capacity of about 62 cfs, thereby permitting the processing of all present dry weather waste water flow.

8. The only practical existing point of disposal for the polluted waste waters, because of the corrosion problem, is the Monsanto Village outlet.

9. The continued use of storage and seepage ponds for the controlled discharge of excess flow during periods of storm runoff would allow economies to be effected in the construction of relief sewers. However, plans for relief of the existing sewer system should provide for the elimination of polluted waste waters from such ponds.

10. At least one natural open drainage channel (Dead Creek) appears to be available for the disposal of storm drainage and relatively unpolluted waste water. Although the right to use this channel appears to be unquestionable, competent legal opinions should be obtained as to the propriety of discharging both storm drainage and clean process water to the channel for disposal to the Mississippi River.

11. The present practice of discharging in-plant storm drainage to the existing sewer system should be discontinued wherever practicable.

12. The extent, type and configuration of future relief sewers built by the Village will bear directly upon the economics of in-plant waste water segregation, particularly where waste discharges are potentially corrosive to the ordinary materials used in sewer construction.

13. Capacity for pumping storm flow from a major part of the Village of Monsanto into the river during high river stages has been provided in the Cahokia pumping station. Only nominal capacity is available for storm water flow in both the existing and proposed pumping stations receiving the discharge from the existing Village sewer system.

REVIEW OF PREVAILING CONDITIONS

The following paragraphs summarize certain of the conditions prevailing in various areas tributary to the Village sewer system. These conditions were determined from discussions with responsible personnel from the larger tributary industries, as well as from a review of the engineering reports relating to the area which have been prepared over the past 15 years.

Clean Waste Water. The American Zinc Company, the Midwest Rubber Reclaiming Company and the Cerro Corporation all have indicated particular interest in the possibilities of discharging clean waste water

from their properties to Dead Creek. These possibilities depend upon the feasibility of in-plant sewer changes, but it is understood that at least partial separation of clean water is possible for all three industries. It will, of course, be necessary to provide conduits in locations convenient enough to allow such discharge. Further, it will be necessary to clarify the legal status of the practice of discharging such waste water to Dead Creek.

Storm Drainage from Developed Areas. As discussed in more detail later in this report, the storm runoff from a substantial part of the developed areas within the Village is now diverted to seepage ponds or drained to areas not tributary to the existing sewer system. Most of the industrial properties appear to be inadequately sewered, in that the sewer capacities generally are not adequate to discharge the runoff from a five-year storm. The small in-plant sewers therefore effectively control the present rates of discharge to the Village system. However, for long-range planning, it is only proper to assume that increased plant sewer capacity will be provided. It then becomes necessary to exercise judgment as to what additional flow will be discharged to the Village system after in-plant sewer improvements are made. The controlling assumptions made for each major industry are discussed later in this report.

Undeveloped Industrial Area. Any new developments on industrial property now vacant undoubtedly will be designed to incorporate water conservation provisions wherever possible. Future dry weather flow therefrom should be a minimum. Storm drainage from the undeveloped areas in the northern part of the Village could continue to be discharged to the present seepage ponds, at least for the foreseeable future. In the southern part of the Village, storm drainage logically could discharge to Dead Creek or its tributaries. When development of the vacant land along Mississippi Avenue occurs, it will be feasible to convey the storm drainage therefrom south along Mississippi Avenue to possibly Queeny Avenue and then east to Dead Creek. However, because of the many indeterminate aspects of future industrial development, particularly along Mississippi Avenue, it appears advisable to defer any specific planning for drainage of the area until actual development becomes imminent.

Surge Ponds. As pointed out previously, there is a strong desire on the part of certain industries to discontinue the use of the Nineteenth Street and the Dead Creek surge ponds as receiving basins for polluted waste waters. Both the Mobil Oil Company and the Cerro Corporation have specifically requested discontinuance of this usage. The Cerro Corporation has indicated that it is contemplating the possibility of expanding its facilities to the east of Dead Creek. Should such expansion

take place, it is probable that the creek channel through the Cerro Corporation property would be enclosed in order to make maximum use of the available property. This portion of the channel would then be eliminated as a surge pond.

Monsanto Company Investigations. Engineering personnel of the Monsanto Company have studied the Village sewer system in considerable detail. Summaries of their studies have been made available to the Consultants. According to these summaries, a rate of storm runoff of 1.5 cfs per acre from the Monsanto Company properties was used by the Monsanto engineers in determining drainage requirements. The normal five-year runoff from developed areas similar to the Monsanto plant (with relative imperviousness on the order of 65 to 70 per cent) would be about 2.3 cfs per acre, where little surface ponding occurs and the time of concentration does not exceed about 20 minutes. However, the Monsanto personnel have indicated that some localized temporary inconveniences from ponding in certain operating areas of their plant can be condoned, and that the sewers need not drain off the surface water at a greater rate than about 1.5 cfs per acre. It is further understood that the existing plant sewer system in some cases is not capable of draining certain areas at a rate greater than about 1.0 cfs per acre, although normal plant improvements in these same areas over a period of time may reasonably be expected to result in increased runoff approaching the 1.5 cfs per acre value. For purposes of this study, a runoff coefficient of 1.5 cfs per acre has been adopted as being appropriate for the Monsanto Company plant area, since this value has been accepted by Company personnel, and further since the drainage within the plant is understood to have been considered by the Company as generally adequate up to the present.

The dry weather waste water flows from the Monsanto Company properties are presumed to be the same as those shown in recent reports,* except that it is understood the flow from the production area north of Monsanto Avenue has recently been reduced by about 1,000 gpm (2.2 cfs) as a result of the installation of cooling towers. It is understood that consideration is being given to the installation of additional cooling towers which may result in further decreases in waste water flow.

Monsanto personnel have expressed doubt that significant separation of relatively clean waste water from polluted water would be practical within their plant. They also have expressed doubt that storm runoff would be sufficiently free from pollutants to allow its discharge to an open channel. This doubt is understandable, since large areas within the plant may be

* Monsanto Company Reports EA 4-276 and 4-455.

subjected to spills and drips of chemicals and oils. However, there certainly are extensive roof and yard areas from which relatively clean storm runoff could be collected and diverted to open channels for disposal. The hydraulic effects resulting from such diversion upon the sizing of the Village sewers are discussed later in this report.

Pumped Flow from Mobil Oil Company. All dry weather flow and storm drainage from the Mobil Oil Company property is collected in sumps, from which the waste water is pumped either directly or indirectly to the Village sewer system. Dry weather flow is handled by a 1,500 gpm (3.3 cfs) pump which discharges to oil separators, from which the waste waters flow by gravity into the Village sewers. When rainfall occurs, a second pump with a capacity of 5,000 gpm (11.1 cfs) discharges directly to the Village sewers. A third pump with a capacity of 800 gpm (1.8 cfs) also discharges directly to the Village system.

Mobile Oil Company personnel have stated that the present drainage requirements of the plant would be satisfied by providing Village sewer capacity sufficient to receive the total present 16.2 cfs capacity of the three pumps, with the further provision that polluted wastes be prevented from entering the Nineteenth Street surge pond. It is understood that under certain conditions mixtures of waste water and storm drainage actually flow upstream in the Monsanto Avenue sewers, with the result that the level of the Nineteenth Street surge pond rises sufficiently to flood the oil separators. The residues left after the water level in the surge pond recedes are quite obviously a serious nuisance and are also known to be a potential fire hazard.

The rate of storm water runoff that the Mobil Oil Company plant now is capable of pumping to the Village sewer system is limited. For example, if the capacity of the pumps (16.2 cfs) which handle all waste water and storm flow from the plant, was assumed to be available for only the main plant area of 27 acres, the average rate of runoff handled by the pumps in addition to the dry weather flow of 3.3 cfs, would be only about 0.41 cfs per acre.

POSSIBLE COURSES OF ACTION FOR RELIEF OF SEWER SYSTEM

Four alternate basic courses of action appear to be available to the Village to accomplish relief of the existing sewer system. All four of these courses of action have been explored at least partially in prior studies, and are further explored in this study. In the following discussion the controlling factors affecting the several courses of action are summarized and a recommendation made as to the course of action which

the Consultants believe is most appropriate for the Village to adopt. The several courses of action, each of which is discussed in more detail hereafter, are as follows:

1. Continuation of the present combined sewer system, supplemented with relief sewers to develop the required total system capacity, and maintaining the Nineteenth Street and Dead Creek surge ponds as surge basins for polluted waste waters.

2. Continuation of the present combined system, supplemented with relief sewers to develop the required total system capacity, but discontinuing the use of the surge ponds.

3. Initiation of a separate sewer system, with additional sewers for relatively clean waste water and storm runoff constructed to bypass the Village waste water treatment plant, and using the surge ponds only as basins for the temporary storage of clean waste water and storm runoff.

4. Initiation of a separate sewer system for relatively clean waste water and storm runoff constructed to lead to the channel of Dead Creek, and using the surge ponds only as basins for the temporary storage of relatively clean waste water and storm runoff.

It will be noted that only in the first case is the continuation of the use of the surge ponds as basins for polluted waste waters given consideration.

Alternate 1. Continuation of Combined System with Surge Ponds. If the existing Village sewers, supplemented with the required relief sewers, were continued to be operated in their present manner, as a combined system utilizing the Nineteenth Street and Dead Creek surge ponds to receive fluctuations in flow, the principal advantage would be the deferral of major capital expenditures. This advantage would apply to the Village as well as to the individual tributary industries. However, there is understood to be a strong local sentiment against the continuation of this mode of sewer system operation, due to the attendant nuisances and potential hazards. A further advantage of continuing the present mode of operation, although possibly of lesser importance, accrues from the diluting and neutralizing effects upon the acidic wastes of the substantial quantities of relatively clean waste waters now carried by the system.

A principal disadvantage of continuation of the present mode of operation of the system as stated above is, of course, the strong local

reaction against the use of the surge ponds for polluted waste waters. A further disadvantage of major importance is the lack of a means of bypassing the proposed Village treatment plant with waste waters not requiring treatment. This inability to bypass waste waters not requiring treatment has not only made necessary a larger treatment plant, but also will result in the payment of service charges for treating waste waters which otherwise could be discharged directly to the river. Because of the presence of corrosive wastes, a third disadvantage accrues from the more expensive materials and methods of construction required in the supplementary relief sewers.

Alternate 2. Continuation of Combined System Without Surge Ponds. Should the surge ponds no longer be permitted to receive polluted waste waters, yet maintaining the existing combined sewer system, all of the main sewers would require extensive supplementation. The most grossly overloaded section would be that through the Monsanto Company property between Mississippi Avenue and the north end of the Dead Creek channel. As under Alternate 1, all of the additional sewers would be required to be built of corrosion-resistant materials. The existing flood protection pumping facilities at the levee would have capacity to handle only a fraction of the total flow, and the outfall conduit between the levee and the river would have to be greatly enlarged. All dry weather flow, whether requiring treatment or not, would be required to flow through the treatment plant, and as a consequence, sewer service charges would have to be levied for all relatively clean dry weather flow, even though it normally could be discharged directly to the river without treatment. Outside of eliminating pollution from the surge ponds, there appear to be no advantages to adopting this course of action, and since the probable capital requirements obviously would be larger than under Alternate 1, no further consideration is given to Alternate 2.

Alternate 3. Initiation of Separate System Generally Paralleling Existing Sewers, Using Surge Ponds for Unpolluted Flow Only. In many respects the system required for this course of action would be similar to that required for Alternate 2. However, although additional conduit and pumping capacity would be required, part of the additional construction could be of less expensive materials. Some provision would be included for bypassing the relatively clean dry weather flow around the treatment works. The capital costs of the improvements required under this plan might be somewhat less than those required for Alternate 2, but would still be of the same general order of magnitude. Since the objectives of this plan can be accomplished much more economically by Alternate 4, as discussed hereafter, no further consideration will be accorded Alternate 3, as long as Alternate 4 is not eliminated from consideration because of conditions other than of an engineering nature.

Alternate 4. Initiation of Separate System Discharging to Channel of Dead Creek, Utilizing Surge Ponds for Clean Waste Water Only. One of the greatest advantages of this course of action would be the economies realized in making use of the upper reach of the natural channel of Dead Creek as a detention basin from which storm runoff and relatively clean waste water could be discharged at moderate rates to the lower reach of the channel and ultimately to the river. In addition, at least at some later date, considerable capital cost benefits could accrue from the use of the existing storage volume provided in the Nineteenth Street surge pond, since storm runoff could be temporarily stored there and allowed to bleed into the combined system when flow capacity in that system becomes available. Since the storage volume in the lower Dead Creek system south of the Village of Monsanto is great, and since the discharge to this system from the Village can be controlled easily, no additional flood protection pumping capacity would be necessary at the Cahokia pumping station. With judicious routing of a new sewer to the Dead Creek channel, a significant part of the relatively clean dry weather waste water could be diverted from the treatment facilities, generally effecting economies for a number of the tributary industries.

The only factor potentially adverse to this plan is that the channel of Dead Creek has been at least partially blocked for some years. The legal aspects of this matter obviously must be resolved before the plan can be adopted, but from the standpoint of equity, it appears unquestionable that the Village has the right to discharge drainage into this natural channel.

Since this fourth course of action obviously is more attractive than any of the first three, the remainder of this study is essentially confined to the development of a long-range plan for this course of action.

GENERAL PLAN OF RELIEF OF SEWER SYSTEM

The long-range plan of relief of the sewer system which appears most appropriate for the Village of Monsanto includes the construction of a sewer to convey clean waste water and storm drainage to the channel of Dead Creek, the construction of relief sewers for the existing Village system, and the retention of the Nineteenth Street and Dead Creek surge ponds for the temporary storage of clean waste water and storm drainage.

The route for the clean water sewer must be such that it will be in a location convenient to the tributary industries to discharge into it storm drainage and waste water of acceptable quality. Preliminary examination of available maps and aerial photographs, together with field reconnaissance, has shown one alignment for this sewer to be superior to other

possible alternate routes. This alignment, beginning at the north end of the channel of Dead Creek, just south of the Alton and Southern Railroad tracks, would run almost due north parallel to D Street in the Monsanto Company property to Monsanto Avenue. At that point one branch would run easterly along the street to a point at which drainage from the Monsanto Avenue parking lot could be picked up. A second branch would run westerly along Monsanto Avenue to Mississippi Avenue. This alignment would allow most of the street drainage from Monsanto Avenue to be diverted to the new sewer, as well as from the Monsanto Avenue parking lot, several yard areas, and a substantial portion of railroad right-of-way. The alignment also would make the sewer available for the American Zinc Company and the Monsanto Company to divert relatively clean waste water to it. The alignment across the Monsanto Company property would allow that industry to discharge to the sewer such roof and yard drainage that would be free from drips and spills which would otherwise make such drainage unacceptable for discharge to an open channel.

Construction of the clean water sewer through the Monsanto Company property will be difficult, and will cause some interference with plant operations. Careful planning and scheduling, and a high degree of cooperation on the part of the contractor, will be required to minimize such interference.

An existing 18-inch sewer, just south of Queeny Avenue, discharges to Dead Creek from Mississippi Avenue. It is understood this sewer will at least require rehabilitation, and possibly reconstruction, to restore it for use. Should such rehabilitation be extensive, it may become justifiable to construct a larger sewer paralleling the same alignment. This sewer would be available for the discharge of clean waste water as well as some storm drainage from the Midwest Rubber Reclaiming Company, storm drainage from the area along Mississippi Avenue, and in the future, should it prove to be desirable, from the parking area of the Darling Fertilizer Company.

Relief of a substantial part of the existing combined sewer system also will be necessary. The most practical alignments for such relief sewers appear to be generally parallel to the existing sewers.

DEVELOPMENT OF DESIGN FLOW QUANTITIES

Table No. I presents the estimated dry weather and storm flow quantities developed for those areas which are considered to be all or in part tributary to the Village sewer system. Certain assumptions have been made in developing these quantities, and the accuracy of these

TABLE NO. I

ESTIMATED WASTE WATER AND STORM RUNOFF QUANTITIES
SEWER SYSTEM - VILLAGE OF MONSANTO, ILLINOIS

Area	Dry Weather Flow			Storm Flow			Total	Flow Available for Discharge to Dead Creek			Flow Assumed to be Discharged to Village Sewer
	Poll. cfs	Clean cfs	Total cfs[a]	Trib. Area acres	P.I. cfs/acre	Flow cfs	cfs	DWF cfs	Storm cfs	Total cfs	cfs
A	0.1	8.4	8.5	0.3[d]	-	0.5	9.0	8.4	0.5	8.9	0.1
B	1.0[c]	-	1.0	b	-	-	1.0	-	-	-	1.0
C	3.0	-	3.0	2.3[d]	1.50[f]	3.5	6.5	-	2.5	2.5	4.0
D	-	-	-	2.0	1.71	3.4	3.4	-	3.4	3.4	-
E	-	-	-	2.8	1.71	4.8	4.8	-	4.8	4.8	-
F	-	-	-	1.8	1.71	3.1	3.1	-	3.1	3.1	-
G	-	-	-	10.0	1.5[f h]	15.0	15.0	-	15.0	15.0	-
H	-	-	-	2.0	1.5[f]	3.0	3.0	-	3.0	3.0	-
I	8.0[c]	-	8.0	b	-	-	8.0	-	-	-	8.0
J	-	-	-	12.0							
K	3.3[a]	-	3.3	27.0	-	12.9[e m]	16.2[e m]	-	-	-	16.2
L	-	-	-	21.0							
M	12.4	11.0	23.4	45.0	1.5[f]	67.5	90.9	5.0	34.0	39.0	51.9
N	0.2	-	0.2	5.0	1.5[f]	7.5	7.7	-	-	-	7.7

(Continued)

TABLE NO. I - Page 2

Area	Dry Weather Flow			Storm Flow			Total	Flow Available for Discharge to Dead Creek			Flow Assumed to be Discharged to Village Sewer
	Poll. cfs	Clean cfs	Total cfs[a]	Trib. Area acres	P.I. cfs/acre	Flow cfs	cfs	DWF cfs	Storm cfs	Total cfs	cfs
O	g	-	-	14.0	-	g	-	-	-	-	-
P	g	-	-	90.0	-	g	-	-	-	-	-
Q	11.1	-	11.1	27.0	1.5[f]	40.5	51.6	-	-	-	51.6
R	-	-	-	14.0	[h]	5.0	5.0	-	-	-	5.0
S	-	-	-	3.6	[h]	5.0	5.0[i]	-	-	-	5.0
T	0.1	-	0.1	[b]	-	-	0.1	-	-	-	0.1
U	1.4	2.0	3.4	5.1[d]	2.47	12.6	16.0[i]	1.0	-	1.0	15.0
V	-	-	-	3.0[d]	2.47	7.3	7.3	-	7.3	7.3	-
W	0.1	-	0.1	1.2	2.02	2.4	2.5	-	-	-	2.5
X	2.8	2.1	4.9	12.6	2.63	33.1[k]	38.0	2.1	16.5	18.6[j]	19.4
Y	0.8	1.0	1.8	9.2	2.63	24.2	26.0	1.0	24.2	25.2[j]	0.8
Z	0.3	1.0	1.3	12.0	1.87	22.4	23.7	1.0	22.4	23.4[j]	0.3
AA	0.1	-	0.1	[b]	-	-	0.1	-	-	-	0.1
AB	1.0[c]	-	1.0	17.0	2.02	35.0	36.0	-	35.0	35.0[j]	1.0
AC	0.2	-	0.2	63.0[b]	[l]	3.9	4.1	-	-	-	4.1
AD	-	-	-	[b]	-	-	-	-	-	-	-
								18.5	171.7	190.2	193.8

(Continued)

a. Estimated peak flow.

b. Assumed to discharge to seepage pond.

c. Estimated future flow.

d. Remainder of area drains to seepage pond.

e. Based upon existing pump capacity.

f. Recommended by Monsanto personnel.

g. Undeveloped area - Recommendation deferred - See text of Report.

h. Controlled discharge assumed.

i. Assumed to flow to existing system for present.

j. Assumed to discharge directly to Dead Creek.

k. 8.3 cfs to discharge to Mississippi Avenue sewer and 8.3 cfs to sewer at Dead Creek.

l. Flow determined as capacity at outlet.

m. Recommended by Mobil Oil Company personnel.

assumptions depends to some extent upon the degree and the practicality of in-plant separation of clean water and storm drainage from polluted waste water. Since only the involved industries can determine the feasible degree of separation, and even then only after detailed in-plant studies, the design flow quantities as presented must be considered as preliminary in nature. It is believed, however, the assumptions made are reasonable, and will serve as guide lines for further internal studies by the individual industries. Each of the areas listed in Table No. I and as shown on Figure No. 3 are discussed in the following paragraphs.

Area A - about 17 acres, is comprised of the American Zinc Company property. The storm drainage from all but a small area along Monsanto Avenue drains to an existing seepage pond (shown on Figure No. 1) north of the plant property. A peak dry weather flow of no more than 0.1 cfs of polluted waste water, presently carried by the same sewers that carry clean waste water, is assumed to be separated from the clean water, and to continue to discharge to the Village combined sewer system. A peak flow of 8.4 cfs of clean cooling water, after separation from the polluted water, would be discharged to the new clean water sewer. A minor quantity of storm runoff, estimated at 0.5 cfs, also is assumed to be tributary to the new clean water sewer.

Area B - about 7 acres, includes Manchester Subdivision, from which all buildings now have been removed. It is understood part of this area may be required for proposed highway improvements. Any polluted waste water flow resulting from the future redevelopment of this area (probably no more than 1.0 cfs) should be discharged to the Village combined sewer system. The topography of the area is such that about half of the area drains naturally southward toward the Village system. However, should the area be redeveloped, it is recommended that all surface drainage be diverted northward toward the existing seepage pond. For design purposes, no surface drainage is assumed to discharge into Village sewers.

Area C - consists of a 17-acre part of the Monsanto Company property lying north of Monsanto Avenue. The assumed dry weather flow of 3.0 cfs of polluted waste water reflects a reduction in flow due to the recent installation of cooling towers. It is understood further reduction in dry weather waste water flow may be effected by the same means. Storm runoff from an area of about 2.3 acres (about 3.5 cfs) is considered as tributary to the present Village system. It is assumed that as much as 2.5 cfs of this flow could be discharged to the clean water sewer, with the remainder continuing to be discharged to the combined system, because of the possibilities of pollution. It is understood that a system of drains and ditches now is being constructed so that surface runoff from all of the

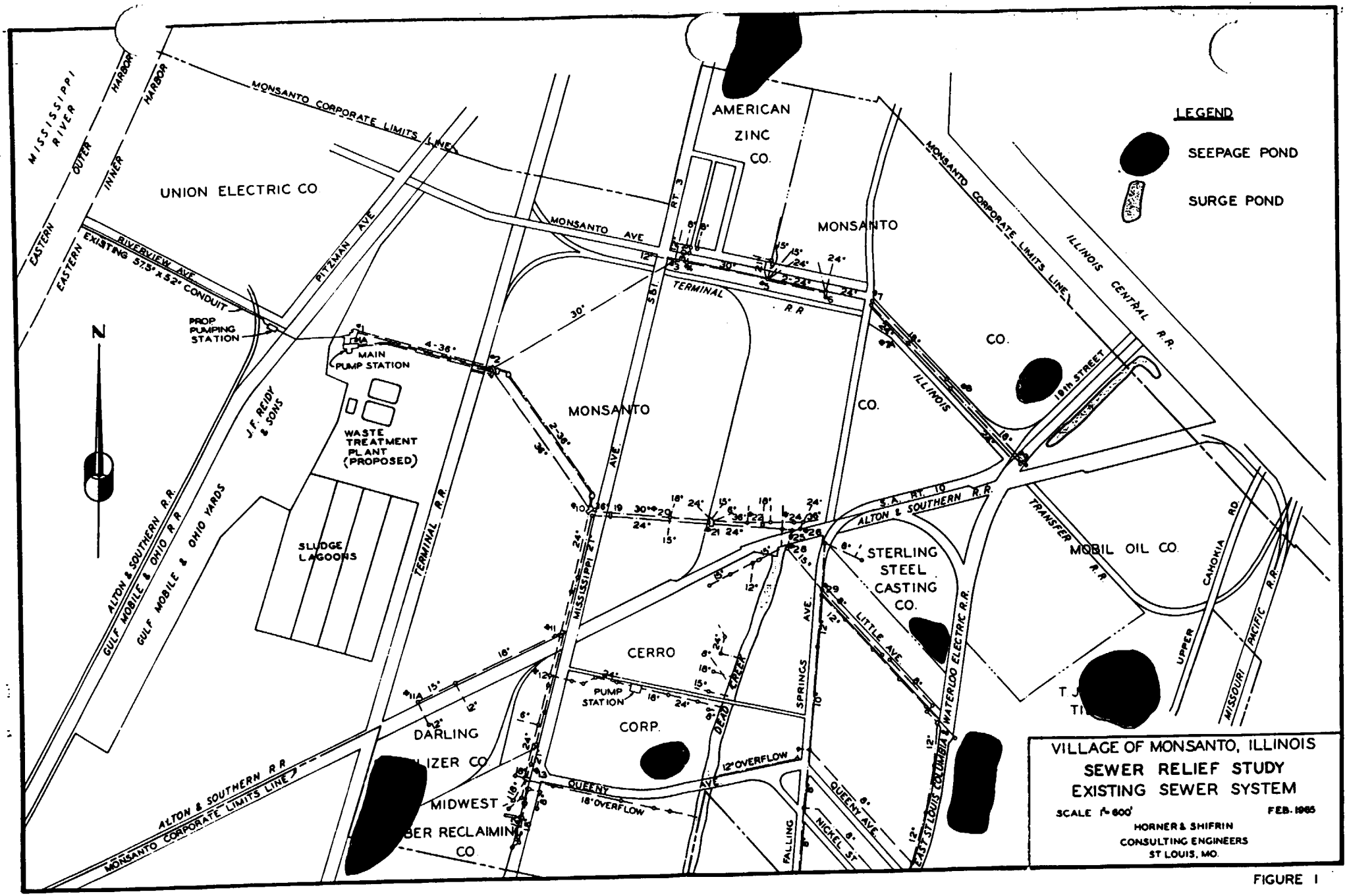

MISSISSIPPI RIVER
EASTERN OUTER HARBOR
INNER HARBOR
MONSANTO CORPORATE LIMITS LINE
UNION ELECTRIC CO
AMERICAN ZINC CO.
MONSANTO
MONSANTO AVE
RT 3
TERMINAL R R
ILLINOIS CENTRAL R.R.
EASTERN EXISTING 5'7.5" x 5'2" CONDUIT
RIVERVIEW AVE
PITZMAN AVE
PROP PUMPING STATION
MAIN PUMP STATION
4-36"
30"
2-36"
36"
J.F. REIDY & SONS
WASTE TREATMENT PLANT (PROPOSED)
SLUDGE LAGOONS
ALTON & SOUTHERN R.R.
GULF MOBILE & OHIO R.R.
GULF MOBILE & OHIO YARDS
TERMINAL R.R.
MISSISSIPPI AVE.
CO.
ILLINOIS
18" ST. STREET
S.A. RT. 10
ALTON & SOUTHERN R.R.
STERLING STEEL CASTING CO.
MOBIL OIL CO.
TRANSFER R.R.
CAHOKIA RD.
UPPER MISSOURI PACIFIC R.R.
LITTLE AVE.
SPRINGS AVE.
WATERLOO ELECTRIC R.R.
CERRO
PUMP STATION
CORP.
DEAD CREEK
DARLING
MIDWEST
CO
12" OVERFLOW
QUEENY AVE
18" OVERFLOW
FALLING
NICKEL ST
EAST ST LOUIS COLUMBIA
LEGEND
SEEPAGE POND
SURGE POND
N
VILLAGE OF MONSANTO, ILLINOIS
SEWER RELIEF STUDY
EXISTING SEWER SYSTEM
SCALE 1" = 600'
FEB. 1965
HORNER & SHIFRIN
CONSULTING ENGINEERS
ST LOUIS, MO.

FIGURE 1

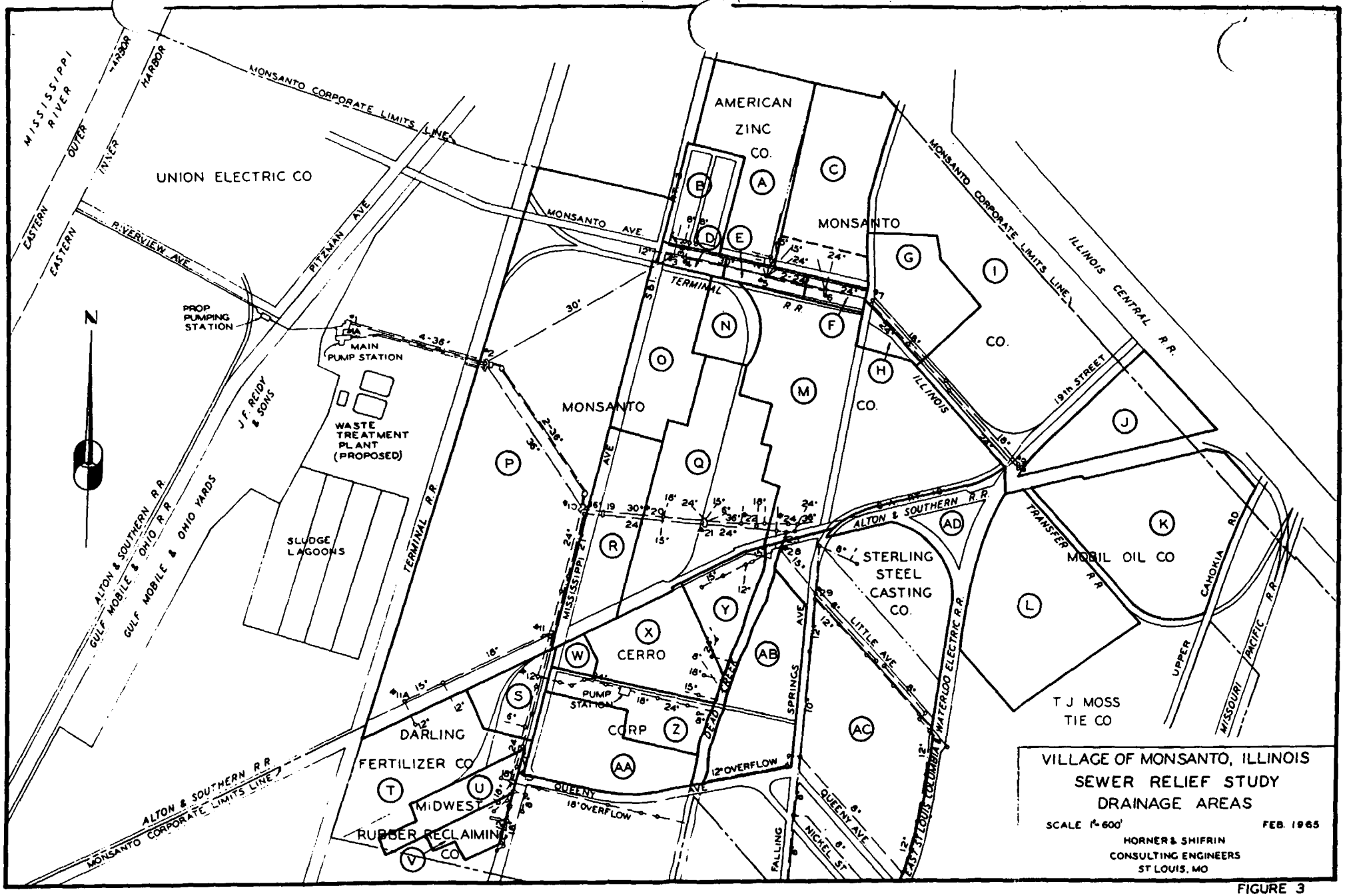

MISSISSIPPI RIVER
EASTERN OUTER HARBOR
EASTERN INNER HARBOR
MONSANTO CORPORATE LIMITS LINE
UNION ELECTRIC CO
RIVERVIEW AVE
PITZMAN AVE
PROP PUMPING STATION
MAIN PUMP STATION
WASTE TREATMENT PLANT (PROPOSED)
SLUDGE LAGOONS
J.F. REIDY & SONS
ALTON & SOUTHERN R.R.
GULF MOBILE & OHIO R.R.
GULF MOBILE & OHIO YARDS
TERMINAL R.R.
AMERICAN ZINC CO.
MONSANTO AVE
MONSANTO
MONSANTO CO.
ILLINOIS CENTRAL R.R.
19th STREET
ILLINOIS AVE
MISSISSIPPI AVE
ALTON & SOUTHERN R.R.
TRANSFER R.R.
STERLING STEEL CASTING CO.
MOBIL OIL CO
CAHOKIA RD
UPPER PACIFIC R.R.
MISSOURI
CERRO
PUMP STATION
DEAD CREEK
SPRINGS AVE
LITTLE AVE
T J MOSS TIE CO
CORP
DARLING FERTILIZER CO
MIDWEST RUBBER RECLAIMING CO
QUEENY AVE
12" OVERFLOW
18" OVERFLOW
FALLING
NICKEL ST
ST. LOUIS COLUMBIA & WATERLOO ELECTRIC R.R.
VILLAGE OF MONSANTO, ILLINOIS
SEWER RELIEF STUDY
DRAINAGE AREAS
SCALE 1"=600'
FEB. 1965
HORNER & SHIFRIN
CONSULTING ENGINEERS
ST LOUIS, MO

FIGURE 3

remainder of the Monsanto Company production area north of Monsanto Avenue will be drained to the existing seepage pond north of the plant.

Areas D, E and F - are comprised of streets and railroad property from which all surface drainage would be discharged to the new clean water sewer. The flow from the 2.0 acres of Area D is computed to be 3.4 cfs, that from the 2.8 acres of Area E to be 4.8 cfs, and that from the 1.8 acres of Area F to be 3.1 cfs.

Area G - consists of a 10-acre paved parking lot, with inlets connected to the present Village combined system. Some ponding is known to occur on this lot, apparently due to inadequate inlet and sewer capacity. For purposes of this study, it is assumed these inadequacies will be corrected, with the result that at least 15.0 cfs of runoff would occur. All of this runoff then would be discharged to the new clean water sewer.

Area H - is about 2.0 acres of railroad and yard area. The runoff of 3.0 cfs from this area could be drained to the new clean water sewer. In this case, the sanitary sewage produced in a small building located within the area would have to be disconnected from the storm drain.

Area I - consisting of about 47 acres, is mainly undeveloped property owned by the Monsanto Company north of Monsanto Avenue. A small industrial plant has been constructed in this area near Monsanto Avenue. Surface drainage from the area presently flows northward to seepage ponds. It is understood the area is considered appropriate for future industrial development by Monsanto. When such development occurs, surface drainage should continue to be discharged northward and should not be permitted to enter the Village sewer system. The amount of dry weather flow from future development is largely a matter of conjecture. It is suggested that for purposes of this study the quantity of dry weather polluted waste water produced in Area I be considered to be about 8.0 cfs, as projected by Monsanto Company personnel in their Report No. 2 (4-455). Any relief sewers required to accommodate present conditions should include capacity for this future flow. However, existing sewers adequate to handle present flows should not be relieved until additional capacity becomes necessary.

Areas J, K and L - are comprised of properties owned by the Mobil Oil Company. Areas J (12 acres) and L (21 acres) are tank farms, and Area K (27 acres) is the main plant production area. The normal runoff from these areas, if sufficient sewer capacity were available to accommodate a 5-year storm, would be on the order of 119 cfs. However, the plant sewers are clearly undersized and only a fraction of the theoretical runoff rate therefore can be discharged through these sewers.

Mobil Oil Company personnel have indicated their present drainage requirements would be satisfied by providing Village sewer capacity sufficient to receive the total present 16.2 cfs capacity of the pumps, and for purposes of this study, the dry weather peak flow is assumed to be 3.3 cfs, and the storm flow to be 12.9 cfs. However, it would appear that normal Mobil Oil Company plant improvements probably would include additions and improvements to the plant sewer system, and it therefore seems advisable to consider the possible future requirement of additional storm flow entering the Village sewer system at some later date.

The two tank farms, consisting mainly of diked areas, are drained by small sewers, which do not have sufficient capacity to prevent ponding within the diked areas during periods of significant storm runoff. Under conditions controlled to prevent the flotation of the tanks within them, the diked areas could continue to be allowed to serve as retention ponds for storm runoff. Further, with relatively minor additions to the plant sewers, it would be possible to divert the storm runoff from the tank farms to either the Nineteenth Street surge pond or to a conduit which would lead to the channel of Dead Creek. In either case, the drainage from the tank farms could be kept out of the Monsanto Avenue sewers during periods of storm runoff. Similarly, any new sewers constructed within the main plant area to improve drainage also could drain to points other than the existing Village sewer system.

Plant cooling water requirements apparently are being adequately served by cooling towers. It is understood that further segregation of waste water and storm runoff within the plant is not considered practical by plant personnel. However, should major improvements within the plant be planned, it is recommended that such planning include the installation of separate storm drains.

Area M - includes about 45 acres of the Monsanto Company's main plant. The total dry weather flow from this area, as indicated by Company personnel, averages about 21.3 cfs. The peak dry weather flow from the area is assumed to be about 10 per cent greater, or approximately 23.4 cfs. Of this amount, about 11.0 cfs is understood to be relatively clean cooling water. Considering the availability of a clean water sewer to handle at least a portion of this cooling water, it is believed proper to assume that about 5.0 cfs could be safely diverted to the clean water sewer.

Using the storm runoff factor of 1.5 cfs per acre, considered satisfactory by Monsanto Company engineers, the total runoff from Area M would be 67.5 cfs. For purposes of this study, it is assumed that in-plant sewer changes can be made to divert about 34 cfs of the total runoff to the proposed clean water sewer. The remaining 33.5 cfs is assumed to be

potentially polluted by drips and spills, or so costly to separate from the polluted wastes that it should continue to be discharged to the Village combined system.

From discussions with Monsanto personnel, there appears to be some doubt as to the amount of storm runoff which could practicably be diverted to the clean water sewer. This matter obviously should be analyzed carefully by Company personnel. It should be recognized by all concerned, however, if the channel of Dead Creek is not available as a surge pond for polluted wastes, as much as possible of the storm water component of the total flow should be directed to Dead Creek, so as to minimize the requirements for additional relief of the existing combined system. For example, should only one-third of the total runoff of 67.5 cfs from Area M, say 22.5 cfs, be available for discharge to the clean water sewer, the remaining runoff, say 45.0 cfs, instead of the assumed 33.5 cfs, would have to be discharged into the more expensive combined system. It is obvious, therefore, that as much storm runoff as possible should be diverted to Dead Creek.

Area N - an area of about 5 acres, also is a part of the Monsanto Company main plant. The dry weather flow from this area, about 0.2 cfs, discharges to the Monsanto Avenue combined system. The storm runoff from the area computed on the basis of 1.5 cfs per acre, would be about 7.5 cfs. Depending upon the degree of pollution of such runoff caused by potential drips and spills, the storm drainage could discharge to either the combined system or the clean water sewer. For purposes of this study, it is assumed this drainage will continue to flow to the combined system.

Area O - is an area of 14 acres of the Monsanto Company plant which presently is not sewered. When this area is further developed, it is assumed that separate sewers will be provided. Dry weather polluted flow should be discharged to the existing combined system. Storm drainage should be diverted to a clean water sewer which would discharge either westward to an expanded flood protection pumping station, or southward to Dead Creek. For purposes of this study, no additional capacity in the Village combined system is included, under the assumption that sufficient capacity would be created in the future by additional future diversion of storm runoff to the proposed clean water sewer. Even should this assumption prove to be incorrect, it would be feasible to construct a separate sewer for polluted wastes directly from Area O to the Village waste treatment plant.

Area P - consists of about 90 acres of undeveloped property west of Mississippi Avenue owned by the Monsanto Company. The same premises outlined for Area O apply as well to Area P.

Area Q - is another large developed segment of Monsanto Company property consisting of about 27 acres. All drainage from this area, both dry weather flow and storm runoff, discharges to the existing Village system. For the present it is assumed that no changes will be made in the sewer system for this area. The average dry weather flow as obtained from Company personnel is assumed to be about 10.1 cfs. Allowing a 10 per cent peaking factor, the design allowance for dry weather flow would be about 11.1 cfs. The storm runoff, based upon the runoff factor of 1.5 cfs per acre, would be about 40.5 cfs. It is possible that a careful in-plant analysis of the existing plant sewers would allow some clean waste water and storm drainage to be diverted to the clean water sewer. However, for purposes of this study, it is assumed that such diversion will not be practical.

Area R - includes a 14-acre partially developed area of the Monsanto Company property which at present is not sewered. The character of the area is such that some temporary ponding of storm runoff may be condoned without creating significant flooding problems. The rate of runoff to the sewers may therefore be reduced even below the 1.5 cfs per acre value, and it is assumed a discharge to the existing sewer system controlled to be about 5.0 cfs would be adequate. No dry weather flow is presently produced in this area, and it is assumed that any produced in the future would be only minor in quantity.

Area S - is comprised of a part of the Darling Fertilizer Company property which drains to a point in their parking lot. Storm drainage from this lot is conveyed to the Village combined system through a 6-inch pipe, thereby allowing no more than about 1.0 cfs of drainage to enter the system. Since some ponding in the parking lot is known to occur, it is quite possible the Company may find it desirable at some future date to supplement the 6-inch outlet. For this study, an allowance of 5.0 cfs is provided for this drainage.

Area T - consists of the main production area of the Darling Fertilizer Company. The dry weather flow from this area consists of about 0.1 cfs of polluted water, which is discharged to the Village combined sewer system. All storm drainage from the area drains southwestwardly to seepage ponds.

Areas U and V - include portions of the Midwest Rubber Reclaiming Company property. Essentially all of the dry weather flow from this plant is produced in Area U. The total peak dry weather flow is about 3.4 cfs, of which about 2.0 cfs consists of cooling water which could be diverted, at least in part, to Dead Creek.

The storm runoff from about 8.1 acres of the Midwest Rubber property is discharged to the Village sewers, with the runoff from the remaining part of the property draining to seepage ponds. The relative imperviousness of the developed portion of the plant is approximately 80 per cent, and the rate of runoff from a 5-year storm normally would be about 2.46 cfs per acre, with a total peak runoff rate of about 19.9 cfs. Storm drainage already is partially separated in the plant sewers, and approximately 7.3 cfs of the total runoff, from Area V, could be discharged to Dead Creek through an existing sewer along Queeny Avenue. Although this sewer may require some rehabilitation or reconstruction, the route of the sewer is favorable for providing significant relief for the existing system.

For purposes of this study, it is assumed that about 1.0 cfs of clean cooling water from Area U, and about 7.3 cfs of storm runoff from Area V will be diverted to Dead Creek. The remaining flow, about 2.4 cfs of dry weather flow, and about 12.6 cfs of storm drainage, would continue to be discharged to the existing Village combined sewer system.

As with other local industries, the plant sewer system may not be completely adequate to handle the runoff from a 5-year storm. It is understood, however, that no serious problems have so far resulted from such inadequacies.

Areas W, X, Y, Z and AA - comprise the main plant area of the Cerro Corporation. The total dry weather flow from these areas is about 8.2 cfs, of which about 4.1 cfs is polluted waste water which must continue to be discharged to the Village sewer system. Most of the remainder of this dry weather flow, about 4.1 cfs, is understood to be relatively clean waste water which could be discharged directly to Dead Creek. The complexity of the Cerro Corporation plant is such that some assumptions must be made as to the probable distribution of polluted waste water flow. Discussions with plant personnel indicate the distribution to be about 0.1 cfs from Area W to the Mississippi Avenue sewer, about 2.8 cfs from Area X, of which 0.8 cfs would discharge to the Mississippi Avenue sewer and 2.0 cfs to the Village sewer at the upper end of Dead Creek (about 0.8 cfs of this amount would discharge directly to the Village system, and about 1.2 cfs would be required to be intercepted by a new sewer along the westerly edge of Dead Creek), about 0.8 cfs from Area Y, all of which would discharge to the sewer at the upper end of Dead Creek, and about 0.3 cfs from Area Z which would be intercepted by the new sewer mentioned in the preceding. About 0.1 cfs of polluted waste water from Area AA would discharge to the Mississippi Avenue sewer.

All of the storm runoff from the 1.2 acres of Area W, about 2.4 cfs, would discharge to the Village combined system in Mississippi Avenue. The total runoff from the 12.6 acres of Area X, about 33.1 cfs, would be diverted to three points, about 16.5 cfs being discharged directly to Dead Creek, about 8.3 cfs to the Mississippi Avenue sewer, and about 8.3 cfs to the Village sewer at the upper end of Dead Creek. All of the runoff from the 9.2 acres of Area Y, about 24.2 cfs, and from the 12.0 acres of Area Z, about 22.4 cfs, would discharge directly to Dead Creek. Runoff from Area AA would continue to discharge to seepage ponds.

The Cerro Corporation plant presently operates a pumping station discharging to Mississippi Avenue. This pumping station has a nominal capacity of 12.0 cfs.

Area AB - is at present undeveloped. Any dry weather flow produced in the future from this area would discharge to the existing Village sewer at the upper end of Dead Creek. Storm drainage from the area discharges directly to Dead Creek. No allowance is made in this study for any flow from Area AB under present conditions. Assuming development of the area similar to that in Areas X and Y, the future dry weather flow from Area AB requiring discharge to the Village combined system is estimated to be no more than 1.0 cfs. When Area AB is developed, the estimated storm runoff is 35.0 cfs, based upon an average 50 per cent imperviousness of the area.

Area AC - consists of the residential portion of the Village and the Sterling Steel Castings Company. Dry weather flow from this area is on the order of 0.2 cfs. Some street inlets are connected to the sewers in the area, and it is assumed that storm runoff from the area discharges to the present Village system in an amount equal to the capacity of the outlet pipe. For purposes of this study, about 4.1 cfs of combined storm water and sewage is assumed to enter the Village combined system at the upper end of Dead Creek. Natural drainage from Area AC is in a southeasterly direction to several low areas which serve as seepage ponds. It is anticipated these ponds will continue to function as seepage ponds for storm runoff for the foreseeable future.

Area AD - a triangular vacant area between three railroad rights-of-way, is landlocked without an outlet. No runoff is assumed from this area.

OUTFALL SEWERS AND PUMPING STATIONS

Present Village of Monsanto Pumping Station. It has been pointed out that the existing Village pumping station is being replaced as a flood

protection facility by a new pumping station currently being designed by the Corps of Engineers. The existing station, after completion of the new station, then will be adapted to pump dry weather waste water flow to the new Village waste water treatment facilities. Should the Village treatment facilities be completed prior to the completion of the new Corps of Engineers pumping station, it is intended that the existing station would serve to pump storm drainage and treatment plant effluent to the river as well as to pump raw waste water to the treatment facilities.

New Corps of Engineers Pumping Station. The current policy of the Corps of Engineers is to provide flood protection pumping capacity equal only to the rate of flow through existing facilities at the line of protection. Therefore, although the new station will discharge to the higher head required as a result of the construction of downstream confinement works along the river, the rate of pumping to be provided will be the same as that of the existing Village station. This capacity is 135 cfs at river state 13, or 115 cfs at river stage 52. Discussions with representatives of the Corps of Engineers have disclosed that this capacity could be increased to 200 cfs at stage 13 by increasing the pump sizes.

Also included in the construction contemplated by the Corps of Engineers are four 42-inch conduits under the levee. These four conduits will be capable of discharging 200 cfs with only nominal head loss, and will replace a corresponding section of the present conduit to the river.

Conduit to River. The existing conduit to the Mississippi River from the present pumping station is a 57-1/2 by 52-inch box sewer. At the gate-closing stage, which is stage 13, the water level of the Mississippi River is about elevation 392.5. Under present Village pollution abatement plans, an overflow weir is to be constructed in the existing pumping station which will permit the diversion of dry weather flow through the proposed waste water treatment facilities. The top of this weir is to be set at elevation 394. From the loss of head curves included in the September 1952 report of Horner & Shifrin,* it will be seen that in order to maintain a hydraulic gradient of 394.0 at the existing pumping station, the existing conduit will permit a gravity flow of only 60 cfs at stage 13. Should rainfall runoff occur at stage 13 with the gates open, and should the total flow including rainfall runoff be equal to the 135 cfs pumping capacity at stage 13, the hydraulic gradient at the existing pumping station would rise to slightly over elevation 400.

The elevation of the top of the discharge bay of the new Corps of Engineers pumping station is set at elevation 436.0, which will allow only

* "Report on Existing Sewerage System, Including Pumping Station and Recommendations for Expansion" - Horner & Shifrin, September, 1952.

115 cfs to be discharged through the existing conduit by pumping at the maximum anticipated river stage.

The preceding discussion points out the gross inadequacy of the existing conduit, and the necessity of supplementing the conduit to achieve the discharge capacity required, which from Table No. I,is almost 194 cfs.

The four new 42-inch conduits under the levee, which are included in the new Corps of Engineers pumping station project, are provided with two 42-inch stubs at their eastern terminus so that two additional conduits may be constructed to supplement the existing 57-1/2 by 42-inch box sewer in this reach. The new Corps of Engineers station also provides a discharge bay from which a new conduit of adequate capacity could be constructed to the river.

RECOMMENDED PLAN OF RELIEF

Tables No. II and III summarize the design of the sewers required to effect the proposed plan of relief. Figure No. 4 shows the general routing of the proposed sewers, and Figures 5, 6, 7 and 8 show their profiles and the hydraulic gradients of the system resulting from the application of the premises described previously.

Clean Water Storage in Dead Creek Channel. The design of the flood protection pumping facilities at the outlet of Dead Creek was based upon the premise that the channel of the creek and its tributaries, together with large borrow pits along the land side of the levee, would serve as storage basins for storm drainage, thereby allowing the installation of substantially less pumping capacity than would otherwise have been necessary. If part of the drainage from the Village of Monsanto is discharged to the channel of Dead Creek, it therefore will be necessary to control the discharge to the lower reach of the channel (below Judith Lane) so that the rate of flow will not be so great as to cause inconveniences downstream.

Under the assumptions made in developing Table No. I, and assuming discontinuation of the discharge of polluted waste water flow to Dead Creek, the total dry weather clean water flow to the channel of Dead Creek is estimated to be about 18.5 cfs, of which 13.4 cfs would be introduced at the north end of the channel, and the remainder (5.1 cfs) at several other points along the channel. Referring again to Table No. I, it will be seen that the total storm runoff anticipated to Dead Creek is estimated at 171.7 cfs, of which 66.3 cfs would enter from the northern end of the channel, and the remainder, 105.4 cfs, from properties contiguous to the channel.

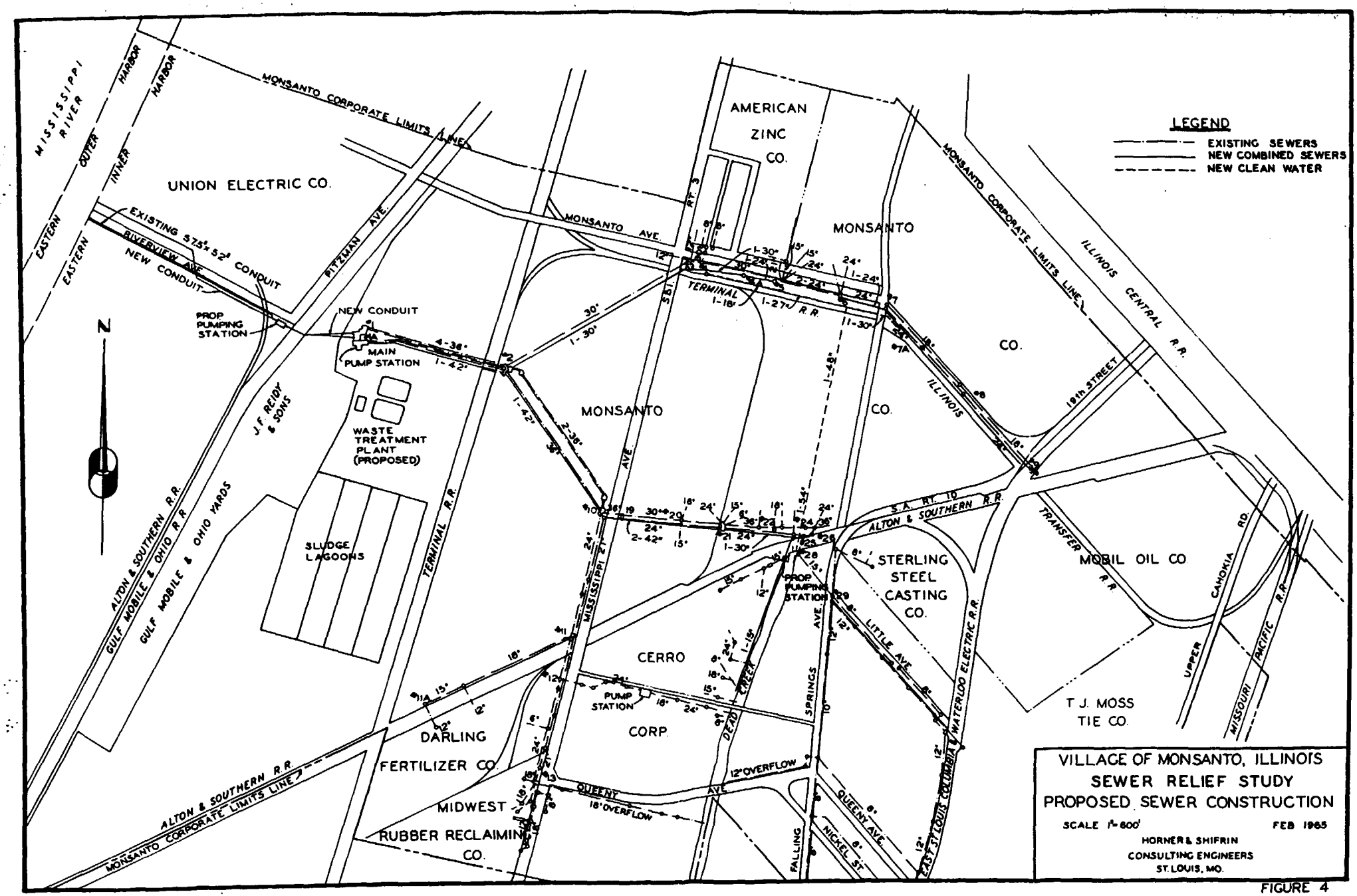
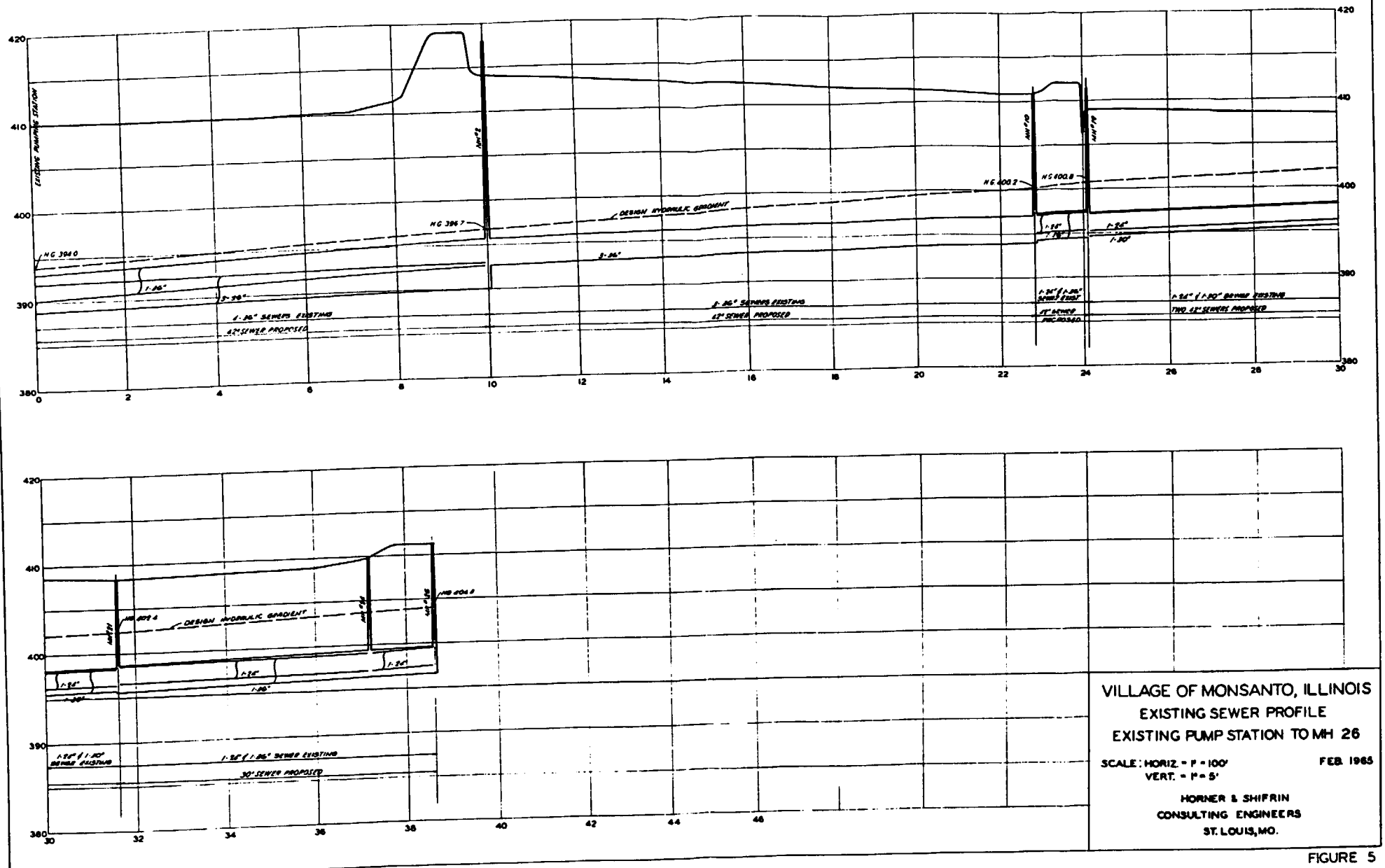

LEGEND
EXISTING SEWERS
NEW COMBINED SEWERS
NEW CLEAN WATER
MISSISSIPPI RIVER
EASTERN OUTER HARBOR
EASTERN INNER HARBOR
MONSANTO CORPORATE LIMITS LINE
UNION ELECTRIC CO.
AMERICAN ZINC CO.
MONSANTO
MONSANTO AVE.
EXISTING 5'7.5"x5'2" CONDUIT
RIVERVIEW AVE
NEW CONDUIT
PROP PUMPING STATION
MAIN PUMP STATION
PITZMAN AVE.
J.F. REIDY & SONS
WASTE TREATMENT PLANT (PROPOSED)
SLUDGE LAGOONS
ALTON & SOUTHERN R.R.
GULF MOBILE & OHIO R.R.
GULF MOBILE & OHIO YARDS
TERMINAL R.R.
S.B.I.
TERMINAL R.R.
ILLINOIS CENTRAL R.R.
19th STREET
S.A. RT. 10
ALTON & SOUTHERN R.R.
TRANSFER R.R.
MOBIL OIL CO
CANOKIA RD.
UPPER MISSOURI PACIFIC R.R.
STERLING STEEL CASTING CO.
PROP PUMPING STATION
LITTLE AVE.
MISSISSIPPI AVE.
CERRO
PUMP STATION
CORP.
DEAD CREEK
SPRINGS AVE.
T.J. MOSS TIE CO.
DARLING FERTILIZER CO.
MIDWEST RUBBER RECLAIMING CO.
QUEENT AVE.
12" OVERFLOW
18" OVERFLOW
FALLING
NICKEL ST.
QUEENT AVE.
ST. LOUIS COLUMBIA & WATERLOO ELECTRIC R.R.
VILLAGE OF MONSANTO, ILLINOIS
SEWER RELIEF STUDY
PROPOSED SEWER CONSTRUCTION
SCALE 1"=600'
FEB 1965
HORNER & SHIFRIN
CONSULTING ENGINEERS
ST. LOUIS, MO.

FIGURE 4



VILLAGE OF MONSANTO, ILLINOIS
EXISTING SEWER PROFILE
EXISTING PUMP STATION TO MH 26

SCALE: HORIZ. = 1" = 100'
VERT. = 1" = 5'

FEB. 1965

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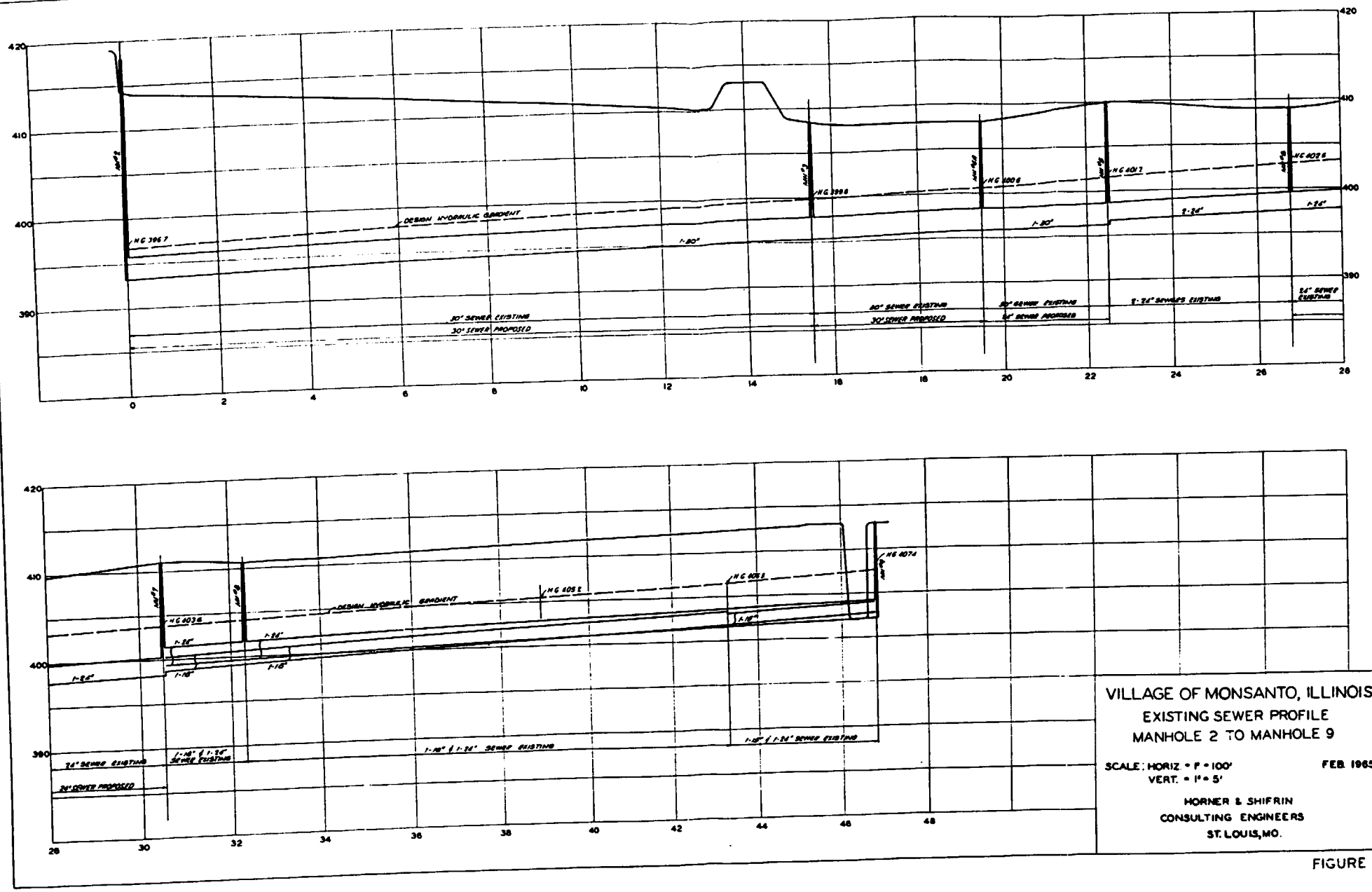
CONSULTING ENGINEERS
ST. LOUIS, MO.

FIGURE 5



VILLAGE OF MONSANTO, ILLINOIS

EXISTING SEWER PROFILE

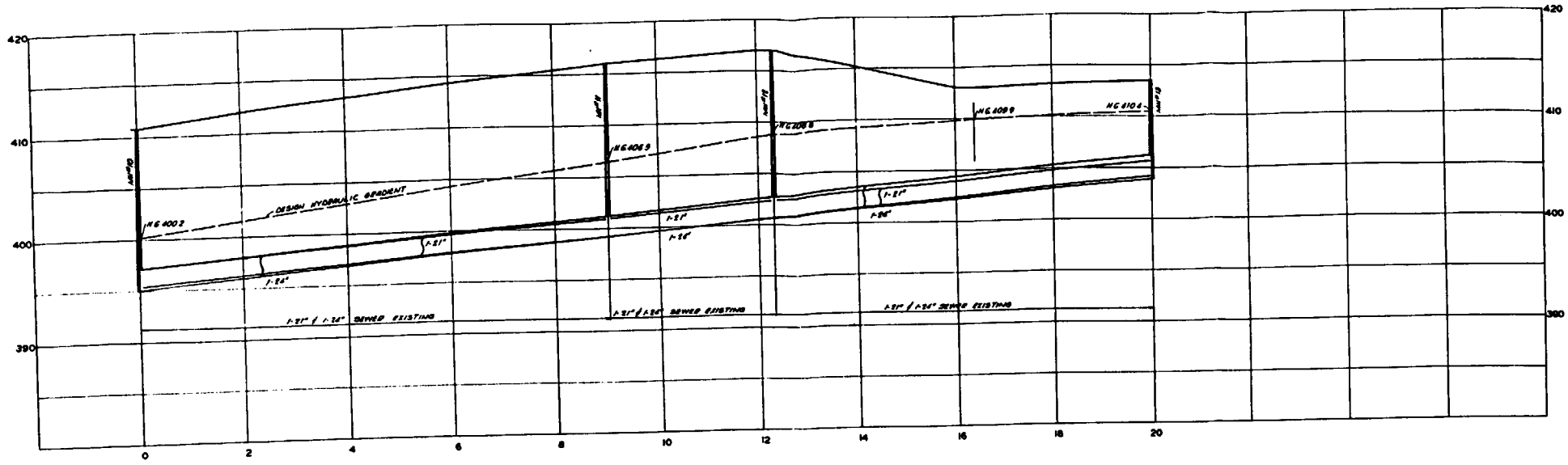
MANHOLE 2 TO MANHOLE 9

SCALE: HORIZ. = 1" = 100'
VERT. = 1" = 5'

FEB. 1965

HORNER & SHIFRIN
CONSULTING ENGINEERS
ST. LOUIS, MO.

FIGURE 6



VILLAGE OF MONSANTO, ILLINOIS

EXISTING SEWER PROFILE

MANHOLE 10 TO MANHOLE 13

SCALE: HORIZ. = 1" = 100'
VERT. = 1" = 5'

FEB. 1965

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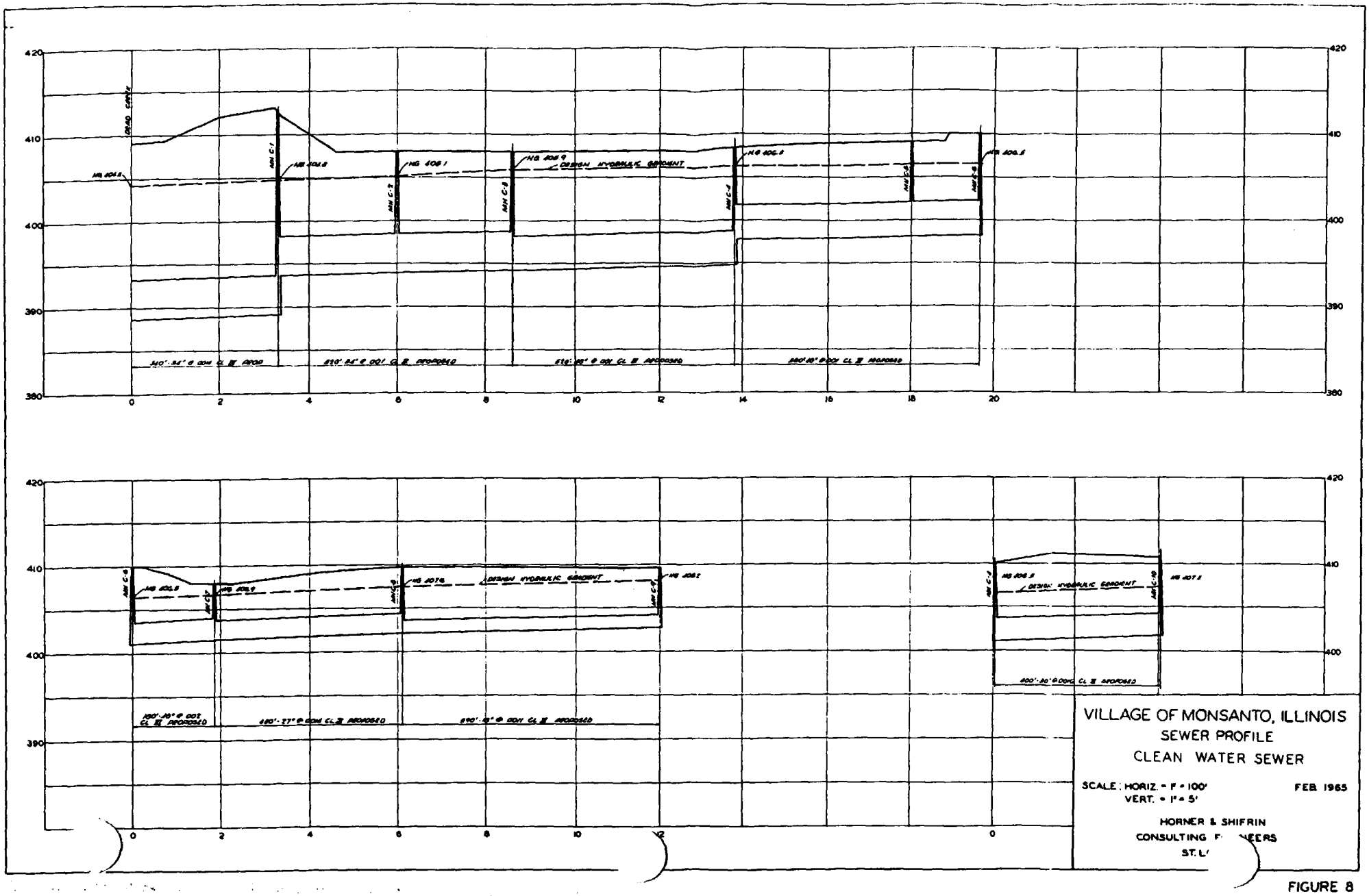
CONSULTING ENGINEERS
ST. LOUIS, MO.

FIGURE 7



VILLAGE OF MONSANTO, ILLINOIS
SEWER PROFILE
CLEAN WATER SEWER

SCALE: HORIZ. = 1" = 100'
VERT. = 1" = 5'

FEB. 1965

HORNER & SHIFRIN
CONSULTING F[illegible]EERS
ST. L[illegible]

FIGURE 8

TABLE NO. II

DESIGN TABLE - VILLAGE OF MONSANTO
SEWER RELIEF STUDY
COMBINED SEWERS

From	To	Distance (ft)	Flow Added (cfs)	Cumulative Total Flow (cfs)	Existing Sewer (dia. in inches)	Proposed New Sewer (dia. in inches)	Hydraulic Gradient	Hydraulic Grade Lower	Hydraulic Grade Upper	Capacity (cfs)
Exist. Pump Sta.	MH#2	1,000	37.0	193.8	Four - 36	One - 42	0.0027	394.0	396.7	194
MH#2	MH#10	1,280	31.8	156.8	Three - 36	One - 42	0.0027	396.7	400.2	158
MH #10	MH #19	130	5.0	125.0	One - 36 One - 24	One - 42	0.0042	400.2	400.8	125
MH #19	MH #21	750	51.6	120.0	One - 30 One - 24	Two - 42	0.0021	400.8	402.4	120
MH #21	MH #26	700	68.4	68.4	One - 36 One - 24	One - 30	0.0028	402.4	404.3	69
				(Design for Future Flows)						
MH #2	MH #3	1,550	1.0	37.0	One - 30	One - 30	0.0020	396.7	399.8	37
MH #3	MH #4A	400	7.7	36.0	One - 30	One - 30	0.0020	399.8	400.6	37
MH #4A	MH #5	300	4.0	28.3	One - 30	One - 24	0.0020	400.6	401.2	24.3
MH #5	MH #6	430	0	24.3	Two - 24	-	0.0029	401.2	402.5	24.4
MH #6	MH #7	370	0	24.3	One - 24	One - 24	0.0029	402.5	403.6	24.4

(Continued)

TABLE NO. II - Page 2

From	To	Distance (ft)	Flow Added (cfs)	Cumulative Total Flow (cfs)	Existing Sewer (dia. in inches)	Proposed New Sewer (dia. in inches)	Hydraulic Gradient	Hydraulic Grade Lower	Hydraulic Grade Upper	Capacity (cfs)
MH #7	Sta 38+90	850	8	24.3	One - 24 One - 18	One - 24	0.0019	403.6	405.2	24.4
Sta 38+90	Sta 43+30	440	0	16.3	One - 24 One - 18	-	0.0024	405.2	406.3	16.3
Sta 43+30	MH #9	350	16.3	16.3	One - 24 One - 15	-	0.0031	406.3	407.4	16.3
				(Design for Present Flows)						
MH #2	MH #3	1,550	1.0	29.0	One - 30	One - 30	0.0012	396.7	398.6	29.0
MH #3	MH #4A	400	7.7	28.0	One - 30	One - 30	0.0012	398.6	399.1	29.0
MH #4A	MH #5	300	4	20.3	One - 30	-	0.0025	399.1	399.9	16.3
MH #5	MH #6	430	0	16.3	Two - 24	-	0.0013	399.9	400.5	16.3
MH #6	MH #7	370	0	16.3	One - 24	-	0.0052	400.5	402.4	16.4
MH #7	Sta 38+90	850	0	16.3	One - 24 One - 18	-	0.0024	402.4	404.4	16.3
Sta 38+90	Sta 43+30	440	0	16.3	One - 24 One - 18	-	0.0024	404.4	405.5	16.3
Sta 43+30	MH #9	350	16.3	16.3	One - 24 One - 15	-	0.0031	405.5	406.6	16.3

(Continued)

TABLE NO. II - Page 3

From	To	Distance (ft)	Flow Added (cfs)	Cumulative Total Flow (cfs)	Existing Sewer (dia. in inches)	Proposed New Sewer (dia. in inches)	Hydraulic Gradient	Hydraulic Grade Lower	Hydraulic Grade Upper	Capacity (cfs)
MH #10	MH #11	900	0.1	31.8	One - 24 One - 21	-	0.0070	400.2	406.5	32.0
MH #11	MH #12	330	11.7	31.7	One - 24 One - 21	-	0.0070	406.5	408.8	32.0
MH #12	Sta 16+40	410	5.0	20.0	One - 24 One - 21	-	0.0027	408.8	409.9	20.0
Sta 16+40	MH #13	360	15.0	15.0	One - 24 One - 21	-	0.0015	409.9	410.4	15.0

Note: n = 0.0012 used for sewers 48-inch and larger

n = 0.0013 used for sewers 42-inch and smaller

TABLE NO. III

DESIGN TABLE - VILLAGE OF MONSANTO
CLEAN WATER SEWER

From	To	Distance (ft)	Max. Dry Weather Flow (cfs)	Max. Wet Weather Flow (cfs)	Total Flow Added (cfs)	Cumulative Total (cfs)	Proposed Sewer (dia. in inches)	Hydraulic Gradient	Hydraulic Grade Lower	Hydraulic Grade Upper	Capacity (cfs)
Dead Creek	MH C-1	340	-	5	5	79.7	54	0.0014	404.3	404.8	80.0
MH C-1	MH C-2	260	2	10	12	74.7	54	0.0012	404.8	405.1	74.0
MH C-2	MH C-3	260	3	7	10	62.7	54	0.0009	405.1	405.3	64.0
MH C-3	MH C-4	520	-	7	7	52.7	48	0.0012	405.3	405.9	54.0
MH C-4	MH C-5	420	-	5	5	45.7	48	0.0009	405.9	406.3	47.0
MH C-5	MH C-6	160	-	3.1	3.1	40.7	48	0.0010	406.3	406.5	49.0
MH C-6	MH C-7	180	-	7.3	7.3	19.6	30	0.0022	406.5	406.9	21.0
MH C-7	MH C-8	430	8.4	0.5	8.9	12.3	27	0.0016	406.9	407.6	13.5
MH C-8	MH C-9	590	-	3.4	3.4	3.4	18	0.0011	407.6	408.2	3.7
MH C-6	MH C-10	400	-	18	18	18	30	0.0019	406.5	407.3	19.5

An analysis of the waste water and storm runoff flows to the channel was made to determine the volume of storage available, as well as the rates of discharge from the storage area north of Judith Lane to the lower reach of Dead Creek south of Judith Lane. It was determined that a 21-inch pipe under Judith Lane would permit about 19 cfs to discharge from the storage area during dry weather flow conditions, with a water surface elevation in the storage area of about 400.0. During periods of storm runoff, over a 3-hour period, the water surface elevation would rise to about 404.3, and the maximum discharge under Judith Lane would be about 44 cfs. The invert elevation of the 21-inch discharge pipe would be about 397.25.

A field reconnaissance of the channel of Dead Creek was made to determine the relative elevations of the existing culverts under the various roads and streets which cross the channel. It was found that the culvert flow line elevations, as well as the channel bottom elevations, were somewhat irregular. In order to avoid the possibility of creating shallow ponds in the channel, it therefore will be necessary to make some relatively minor adjustments in certain of the culvert elevations as well as to perform some minor grading of the channel bottom.

Storage in Nineteenth Street Surge Pond. Under the plan of improvements recommended, the Nineteenth Street surge pond also will be eliminated as a receiving basin for polluted waste water. When the capacities of the Monsanto Avenue sewers are increased to handle the total flow from the Mobil Oil Company plant, and when certain clean waste waters and storm drainage are diverted to the proposed clean water sewer, the Nineteenth Street pond will receive only storm runoff from a relatively small area in its immediate vicinity. In the future, should the Mobil Oil Company find it necessary to enlarge their plant sewers to provide better in-plant drainage, it is recommended that the Mobil plant be required to effect separation of storm drainage so that the additional storm runoff will be discharged directly to the Nineteenth Street pond. A backwater valve would be installed on the existing sewer system to prevent polluted waste water from entering the pond, but to allow any water collected in the pond to drain to the existing combined sewer system when capacity becomes available.

New Clean Water Sewer. The new clean water sewer is shown in general plan on Figure No. 4 and in profile on Figure No. 8. The estimated total flow for which the lower reach of this sewer should be designed is 79.7 cfs. The maximum allowable hydraulic gradient would be controlled by the maximum water level in the Dead Creek storage pond, which is estimated to be about elevation 404.3. The hydraulic gradient at the upper ends of the east and west branches of this sewer would be just under the existing ground surface. The sewer, consisting of 54-inch concrete

pipe at its lower end, would gradually decrease to 18 and 30-inch pipe at the upper terminals. The sewer would be laid at a depth which would minimize interference with existing utilities. A special inverted siphon structure would be required where the sewer would cross under the existing Village combined sewers near the Alton and Southern Railroad tracks to enter Dead Creek. Provisions would be made to allow the easy removal of gravel and other materials which might settle in this special structure.

Queeny Avenue Sewer. It is anticipated that the existing 18-inch sewer south of Queeny Avenue can be cleaned out and rehabilitated so that it may be used to convey about 7 cfs of clean waste water and storm runoff directly to the channel of Dead Creek.

Additions to Existing Combined System. For purposes of discussion, the additions required to the existing combined sewer system are separated into the following groups:

1. Outfall conduit to river.
2. Modifications to Proposed Pumping Station.
3. Main sewer from Existing Pumping Station to Terminal Railroad Association tracks.
4. Monsanto Avenue sewer.
5. Main sewer between Terminal Railroad Association tracks and Mississippi Avenue.
6. Village South Main sewer.
7. Mississippi Avenue sewers.
8. Interceptor along Dead Creek.

1. Outfall Conduit to River. It is understood the capacity of the connecting conduit between the existing Village pumping station and the proposed new Corps of Engineers pumping station is being reviewed by others. No recommendation for supplementing the existing conduit therefore would be in order in this report, and no such recommendation is made. It is suggested, however, that the necessity for increasing the capacity of the conduit in this reach be given consideration in the plan of relief finally adopted by the Village.

The existing 52 by 57-1/2-inch conduit between the proposed Corps of Engineers pumping station and the river will require supplementation to provide adequate capacity under conditions allowing gravity flow. The 1952 report of Horner & Shifrin recommended the construction of a 7-foot by 7-foot box sewer for the outlet to the river. From every indication, this recommendation would appear to still be valid.

2. Modifications to Proposed Pumping Station. As discussed previously, the proposed Corps of Engineers pumping station will pump only 135 cfs at river stage 13, in accordance with the criteria under which the station as presently contemplated is designed. However, it is understood from the Corps of Engineers that the specifications for the pumps and motors could be changed to provide 200 cfs at stage 13, if the difference in cost can be guaranteed by responsible local interests. Since it is highly important to the Village to have adequate pumping capacity at the line of flood protection to accommodate the anticipated flow during periods of rainfall runoff, it is recommended that immediate steps be taken to negotiate with the Corps of Engineers for the provision of at least 200 cfs of pumping capacity in the proposed station.

3. Main Sewer from Existing Pumping Station to Terminal Railroad Association Tracks. Four 36-inch conduits now serve the Village system in this reach. As shown in plan on Figure No. 4 and in profile on Figure No. 5, it is recommended that one additional 42-inch conduit be constructed. This additional conduit would permit the estimated total flow of 194 cfs to be accommodated within the limits of acceptable levels of the hydraulic gradient for this reach.

4. Monsanto Avenue Sewer. Assuming diversion of clean waste water and the quantity of storm drainage previously estimated from the existing Village combined sewer in Monsanto Avenue to the proposed new clean water sewer to Dead Creek, it would be possible to confine the immediately required relief sewers in this reach to one additional 30-inch sewer between Manhole No. 2 (east of the Terminal Railroad Association Tracks) and Manhole No. 4A in Monsanto Avenue. In the future, when the vacant Monsanto Company property north of Monsanto Avenue is developed, it will probably be necessary to construct an additional 24-inch sewer between Manholes 6 and 7, and between Manholes 4A and 5, to accommodate the estimated increase in waste water flow. These recommended sewers are shown on Figures 4 and 6.

5. Main Sewer Between Terminal Railroad Association Tracks and Mississippi Avenue. From Manhole No. 2 at the Terminal Railroad Association tracks southeastward to and across Mississippi Avenue, it is recommended that the existing combined sewers be supplemented by

an additional 42-inch conduit. The recommended conduit is shown in plan on Figure No. 4 and in profile on Figure No. 5.

6. South Main Sewer. Eastwardly from Mississippi Avenue to the north end of Dead Creek, it is recommended that the main Village sewers through the Monsanto Company property be supplemented by two additional 42-inch conduits between Manholes No. 19 and 21, and by one additional 30-inch conduit from Manhole 21 to Manhole 26. This reach of the existing system, shown in profile on Figure 5, is the most grossly overloaded part of the system.

7. Mississippi Avenue Sewers. Under the plan of improvements contemplated, no additional sewer capacity will be required for the sewers along Mississippi Avenue. The anticipated hydraulic gradient for this reach is shown on Figure 7.

8. Interceptor Sewer Along Dead Creek. A relatively small sewer and a pumping station will be required along the westerly side of the channel of Dead Creek to permit the interception of polluted waste water flow from the Cerro Corporation plant. The construction of this interceptor, together with the discontinuance of the free connection between the Village combined system and the channel of Dead Creek, will effectively eliminate polluted waste waters from the channel, and will allow the storage of clean waste water in the channel, and its subsequent discharge to the river.

Normally the pumping station will not be required to operate, but during flows approaching the design wet weather flow, the hydraulic gradient in the sewers would be such that portions of the Cerro Corporation plant would be subject to flooding from the sewers. Controls at the pumping station would automatically start the pumps under these conditions.

ESTIMATED COST OF IMPROVEMENTS

The estimated costs of the recommended improvements have been determined from unit quantity and material take-offs from the preliminary plans and profiles included in this report. The following estimated costs for each of the major components of the recommended improvements include construction contingencies as well as engineering and administration costs.

	Item	Estimated Cost
1.	Modification of Proposed Corps of Engineers Pumping Station	To be determined by others
2.	30-Inch Sewer Between Manholes 2 and 4A	$254,600
3.	Dead Creek Interceptor and Pumping Station	149,400
4.	42-Inch Sewer from Existing Pumping Station to Manhole No. 2	128,100
5.	42-Inch Sewer from Manhole 2 to Manhole 10	187,700
6.	42-Inch Sewer from Manhole 10 to Manhole 19	40,200
7.	Additional Conduit between Existing Pumping Station and New Corps of Engineers Station	To be determined by others
8.	Conduit to River from New Corps of Engineers Station	345,000
9.	42-Inch Sewers Between Manholes 19 and 21, and 30-Inch Sewer Between Manholes 21 and 26	412,700
10.	Clean Water Sewer	508,500
11.	Grading and Culverts in Dead Creek	30,000
12.	Rehabilitation of Queeny Avenue Sewer	10,000
	Total	$2,066,200 *
	(Say	$2,070,000)

* Not including costs to be determined by others.

RECOMMENDED SCHEDULE OF CONSTRUCTION

It must be recognized that even when the Nineteenth Street and Dead Creek surge ponds are permitted to receive polluted waste waters with the Village sewer system as presently constituted, the runoff from a 5-year storm causes a certain amount of flooding in several industrial areas. The elimination of these surge ponds as receiving basins for the polluted flow will immediately make the existing sewers completely inadequate.

The area tributary to the existing sewers, with certain exceptions noted in preceding parts of this report, is, for all practical purposes, completely developed, and only relatively minor increases in both dry weather flow and storm drainage can reasonably be anticipated. As a result of these conditions, it may be concluded that essentially all of the recommended relief sewers should be built under a single continuing and coordinated program. Further, unless extensive additional development in the tributary area occurs, of a character completely different from that anticipated, the sewer additions as recommended will adequately accommodate the sewerage and drainage requirements of the Village.

The sewerage improvement program as conceived is completely dependent upon the use of the channel of Dead Creek for the discharge of clean waste water and part of the storm drainage to the Mississippi River. Prior to construction of the required facilities, or even prior to arranging financing for such construction, it is recommended that competent legal counsel be retained to thoroughly explore the rights of the Village in making use of the channel. Assuming that no factors legally adverse to such use are found, the improvements could be constructed under one contract, or should the Village prefer, under several contracts. Again, it must be recognized that polluted wastes cannot be eliminated from either of the existing surge ponds without constructing all of the improvements proposed. The scheduling of construction suggested in the following therefore is intended only to provide a logical sequence of construction of components of the improvements, considering all of the improvements as parts of a project which must be completed in its entirety before it can function as intended. Should the Village find it impractical, for financial or other reasons, to complete all of the recommended improvements at one time, it is strongly recommended that any improvements made be in conformance with the plan recommended herein. The suggested breakdown of the total project is as follows:

1. Contact the Corps of Engineers, through the Levee District if necessary, to arrange for installing pumps in the new station capable of delivering 200 cfs at stage 13 instead of the pumps of lesser capacity now contemplated.

2. Construct the 30-inch sewer between Manholes No. 2 and 4A, a distance of 1, 950 feet, at an estimated cost of $254, 600.

Should the Village find it necessary to defer part of the recommended improvements, some benefit could be achieved by steps 3 and 4, with the qualifications as noted for each step.

3. Construct the 24-inch sewer between Manholes 4A and 5, at an estimated cost of $25, 100. (This sewer would normally be required to accommodate future waste water flow, and could be deferred if all of the clean water sewer were constructed immediately. However, it would be required at once if the clean water sewer were deferred.)

4. Construct a portion of the clean water sewer between the parking lot north of Monsanto Avenue and the vicinity of Manhole No. 6. A temporary connection would be provided to Manhole No. 6. (The construction of this portion of the clean water sewer also would be an expedient to provide some relief for the Monsanto Avenue sewer.) Its estimated cost is $25, 000.

5. Construct the interceptor sewer and pumping station along Dead Creek to intercept polluted waste waters from the Cerro Corporation. This sewer would be about 1, 500 feet long, with an estimated cost of $149, 400, including the cost of the pumping station.

6. Construct the 42-inch sewer from the existing pumping station to Manhole No. 2, thence to Manhole No. 10, and thence under Mississippi Avenue to Manhole No. 19. The total length of this sewer is approximately 2, 275 feet, and its total estimated cost is $356, 000.

7. Arrange for the construction of the additional conduit capacity (to be determined by others) between the present pumping station and the new Corps of Engineers pumping station. This capacity under the plan proposed in this report would be required to be 200 cfs.

8. Construct the recommended conduit to the river from the new Corps of Engineers station, at an estimated cost of $345, 000.

9. Construct the two 42-inch sewers between Manholes 19 and 21, and the 30-inch sewer between Manholes 21 and 26, a distance of 1,450 feet, at an estimated cost of $412,700.

10. Construct the clean water sewer in its entirety, including a total length of about 3,560 feet of sewer of various sizes, at an estimated cost of $488,000 (not including Item 4).

11. Arrange for the grading of the channel of Dead Creek and the adjustments required in certain of the downstream culverts, at an estimated cost of about $30,000.

12. Arrange for the rehabilitation of the Queeny Avenue sewer, at an estimated cost of $10,000.

The total estimated cost of all of the improvements recommended, except Item No. 3, which could be deferred if all of the remainder of the improvements were built, and Item No. 1 and Item No. 7, the cost of which will have to be determined by others, is $2,070,700.

It should be borne in mind that construction costs have been increasing at a rate approximating 5 per cent per year, with no indication that this rate will decrease. It appears inevitable that polluted waste water will have to be eliminated from the existing surge ponds, and that there is no apparent advantage in deferring the construction of the improvements as proposed. It therefore is recommended that the Village proceed with the proposed program of improvements as expeditiously as possible.

FUTURE IMPROVEMENTS TO SYSTEM

As mentioned previously, when the presently vacant land owned by the Monsanto Company north of Monsanto Avenue is developed, it probably will become necessary to supplement the existing sewer in one reach. At such time when sufficient additional flow is anticipated, an additional 24-inch sewer will be required between Manholes 6 and 7, a distance of about 370 feet. In addition, should all of the improvements recommended for immediate construction be built, Item No. 3, between Manholes 4A and 5, as described in the preceding section of this report, could be deferred until new industrial development creates additional waste water flow.

It also has been pointed out that two potential points of discharge for storm drainage from the presently undeveloped areas along Mississippi

Avenue appear to be available. The additional storm drainage from these areas could be discharged either to an expanded Village pumping station and outfall conduit, or to a future conduit routed southward along Mississippi Avenue to say Queeny Avenue, and then eastward to Dead Creek. It is recommended that this matter be deferred until the extent and type of development along Mississippi Avenue can be defined.

POTENTIAL MODIFICATION OF RECOMMENDED PLAN

The necessity of clarifying the legal status of discharging drainage from the Village of Monsanto to the channel of Dead Creek has been stressed previously. Due to the well-defined channel of Dead Creek, and the obvious present use of the channel as a means of conveying natural drainage to the Mississippi River, it appears that at least that part of the storm runoff from the Village of Monsanto, naturally tributary to Dead Creek, could be discharged to the channel without rational objection. However, this report recommends that dry weather flow of clean water, on the order of 19 cfs, be discharged to this same channel. A flow of this magnitude, even of clean water, could conceivably be construed as a nuisance to downstream owners of property contiguous to Dead Creek, since at the present time there is no flow in the channel during dry weather.

Should legal counsel find a sound basis for recommending that the dry weather flow of clean water be prevented from entering the channel, the only recourse for the Village would be to continue to discharge such water to the Village combined sewer system. Under this circumstance, the sizes of certain of the recommended relief sewers would have to be increased.

In order to maintain acceptable hydraulic gradients, the proposed relief sewer between Manholes 21 and 26 would have to be increased from 30-inch to 36-inch and the proposed relief sewer between Manholes 2 and 4A also would have to be increased from 30-inch to 36-inch. The increased capital cost of these modifications is estimated to be $31,000. Although this additional capital cost is not significant, the increased service charges for sewage treatment would be a continuing annual cost, if this clean water dry weather flow is discharged to the existing Village sewer system. Assuming the average daily flow of this clean water to be about 16.8 cfs, the additional pumping cost alone would be on the order of $5,000 per year. Since the resolution of this matter depends upon a legal question, as well as upon the results of further study on the part of certain of the tributary industries, it is recommended that further consideration of this matter and its effects upon the design of the sewers recommended be deferred until the sewers are ready for final design, under the assumption that both the legal question and the practicaility of in-plant industrial waste separation will be resolved by that time.